LAUDA

Operating Instructions

LAUDA High-temperature Thermostat
USH 400
with R 403 PL
USH 400/6
with R 406 PL

Valid from series LTH 109-08-0002
LTH 211-08-0006
from software version 2.21
08/2008 replaces release Z 01 01/01
YATE0012

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1 Technical data (to DIN 12876)

1.1 Thermostat

		USH 400	USH 400/6
Ambient temperature range	(°C)	5 ... 50	
Operating temperature range	(°C)	0 ... 400	
Working temperature range	(°C)	80 ... (250) 400	
with MVH	(°C)	20 ... 400	
with MVH and extra chiller	(°C)	0 ... 400	
Temperature probe		Pt100 Class A to DIN IEC 751	
Temperature accuracy (ext. volume 1 L.)	(±°C)	0.02 ... 0.1*)	0.02 ... 0.2*)
Heating rating, max.	(kW)	3.0	5.6
Heater surface loading	(W/cm^2)	approx. 3	approx. 6
Safety functions		2nd resistance thermometer and level detector	
Simplex pump			
Flow at zero head (pump output)	(l/min)	22	
discharge pressure, max.	(bar)	0.8	
Liquid volume	(l)	1.9	
Expansion volume	(l)	0.9	
with extra expansion vessel			
Liquid volume	(l)	2.1	
Expansion volume	(l)	2.2	
Heat transfer fluid 80 ... 350°C		Ultra 350 Do <u>not</u> use water!	
Base area (dia.) x height (thermostat only)	(mm)	(180) x 540	
Weight (without R 403 PL/R 406 PL)	(kg)	17	
Units are conform to EU Guideline 89/336/EWG (EMC) and 73/23/EWG (low-voltage) and carry the CE mark			
Supply		Protection class 1 to VDE 0106 230 V; 50 Hz 230 V; 60 Hz 3.2 kW	 230/400 V; 3/N/PE 50 Hz 5.8 kW
Cat. No. (Thermostat + control and operating element)		LTH 109 LTH 209	LTH 211
Cat. No. (thermostat only)		TTH 109-1	TTH 211-1

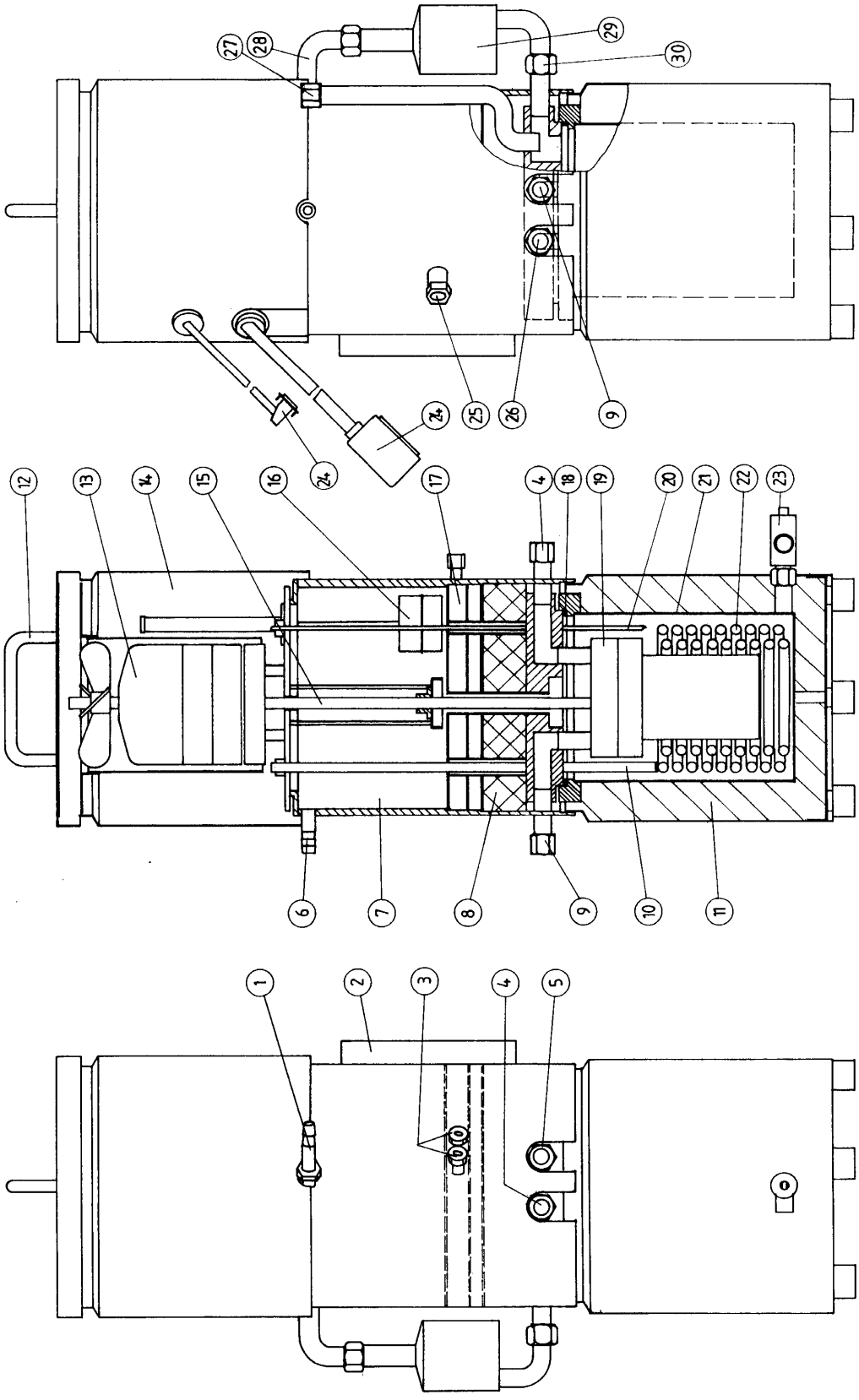
*)see 2.3

1.2 Control and operating element R 403 PL/R 406 PL

Ambient temperature	(°C)	5 ... 40
Temperature controller		
Control range	(°C)	-30 ... 405
Temperature setting/ resolution		membrane keypad with 16 keys, setpoint input with 0.01°C resolution
Temperature measurement outflow		built-in digital thermometer with 0.01°C resolution. Accuracy and stability of measurement (electronics without probe) better than 0.05 % □ 0.05 K *). Temp. probe Pt 100 according to DIN IEC 751, can be calibrated additively at each measurement point.
External temperature measurement		2 separate temperature measurement circuits for ext. Pt 100 to DIN IEC 751 in 4-wire circuit, accuracy and stability of measurement better than 0.05% □0.05K *), can be calibrated additively at each measurement point. One probe produces the measurement for external control.
Display		back-lit LCD matrix display, two lines with 16 signs each, 10 mm character heigth.
Temperatue control		modified PID controller with automatic structure selection. Control parameters through auto-adaption or manual input. With external control a cascade controller operates on the measurement of one of the two external circuits (T_1 or T_2).
Heating actuator		Triac zero crossing with full wave PWM. Limitation of the heater surface temperature to approx. 12 K above the outflow temperature.
R 403 PL		output max. 3 kW / 14 A
R 406 PL		output max. 5.6 kW / 14 A
Automatic filling		heating OFF, pump is activated by level detector
Control circuit for controlled cooling MVH		Triac control of the control valve for the oil circuit and the cooling water solenoid valve 230 V; 50/60 Hz, max. 0.2 A
Safety devices		In the working temperature range adjustable overtemperature protection and adjustable low level cut-off. Pump and heater are switched off on all poles
Overtemperature measurement		Pt 100 in the thermostat
Level indication		in 10 steps
Extra functions		Warning indication and switch-off of the heating for motor chamber temperature floating contact (changeover)
Interface connectors according to NAMUR recommendation		overall fault, input fault, analogue signals, 2 x Pt 100 Ext
Digital interface		RS 232 C

*)see Item 2.3

		R 403 PL	**R 406 PL**
Bench area (W x D x H)	(mm)	190 x 200 x 180	310 x 200 x 195
Weight	(kg)	4	5.5
Supply	230 V; 50/60 Hz	230/400 V; 3/N/PE 50 Hz	
		3.2 kW	5.8 kW
		Protection class 1 to VDE 0106	
Cat. No.		LRK 020	LRK 221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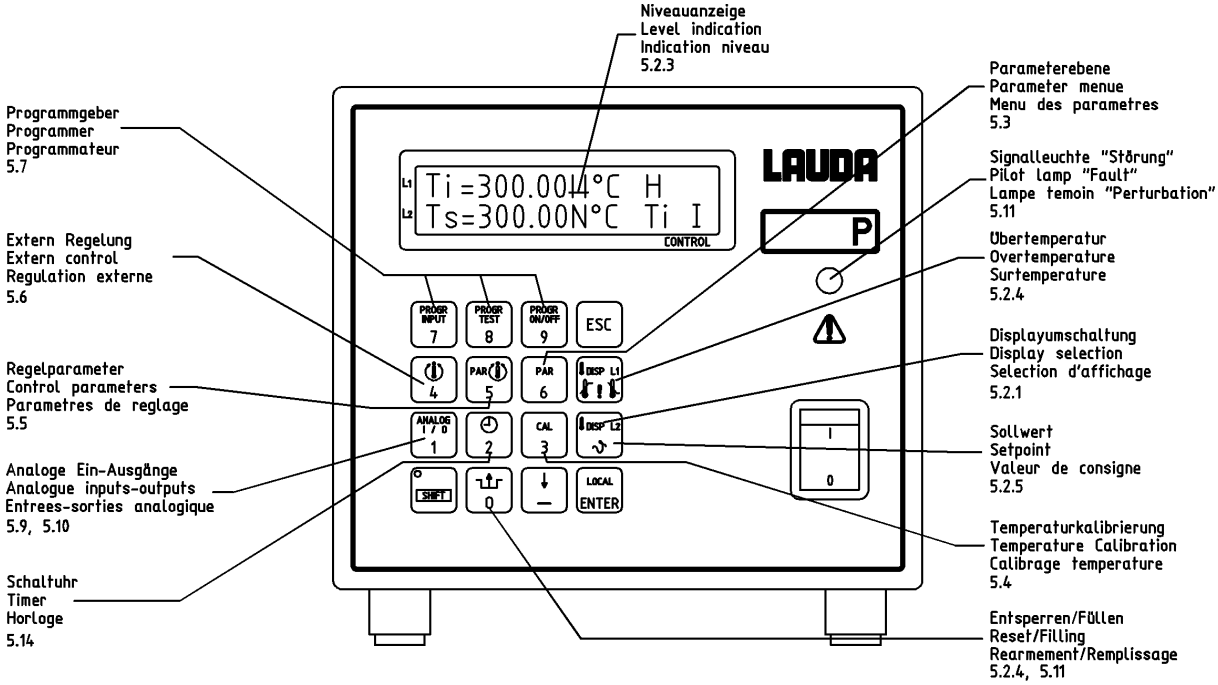
4
5

1	Overflow M 16 x 1 dia. 13 mm
2	Fixing strap with two threads M 10
3	Connections for cooling chamber M 14 x 1.5
4	Pump connection "Outflow 1" M 16 x 1
5	Pump connection "Return 1" M 16 x 1
6	Inert gas connection 10 mm dia.
7	Expansion vessel
8	Insulation
9	Pump connection "Outflow" M 16 x 1
10	Temperature probe "Safety circuit"
11	Insulation
12	Handle
13	Pump motor
14	Motor chamber
15	Pump shaft
16	Float for level detector
17	Cooling chamber
18	Seal
19	Pump
20	Temperature probe "Measurement"
21	Thermostating tank
22	Heater USH 400 (3 kW); USH 400/6 (5,6 kW)
23	Drain cock
24	Control cable with special plug
25	Connection "Extra expansion vessel" M 16 x 1
26	Pump connection "Return 2" M 16 x 1
27	Filler opening M 16 x 1
28	Connection "Vent valve" M 16 x 1 (expansion vessel)
29	Vent valve
30	Connection "Vent valve" (thermostating tank)


Niveauanzeige
Level indication
Indication niveau
5.2.3
Parameterebene
Parameter menue
Menu des parametres
5.3
Programmgeber
Programmer
Programmateur
5.7
Signalleuchte "Störung"
Pilot lamp "Fault"
Lampe temoin "Perturbation"
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Extern Regelung
Extern control
Regulation externe
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Overtemperature
Surtemperature
5.2.4
Regelparameter
Control parameters
Parametres de reglage
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Display selection
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Setpoint
Valeur de consigne
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Schaltuhr
Timer
Horloge
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Temperature Calibration
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Entsperren/Füllen
Reset/Filling
Rearmement/Remplissage
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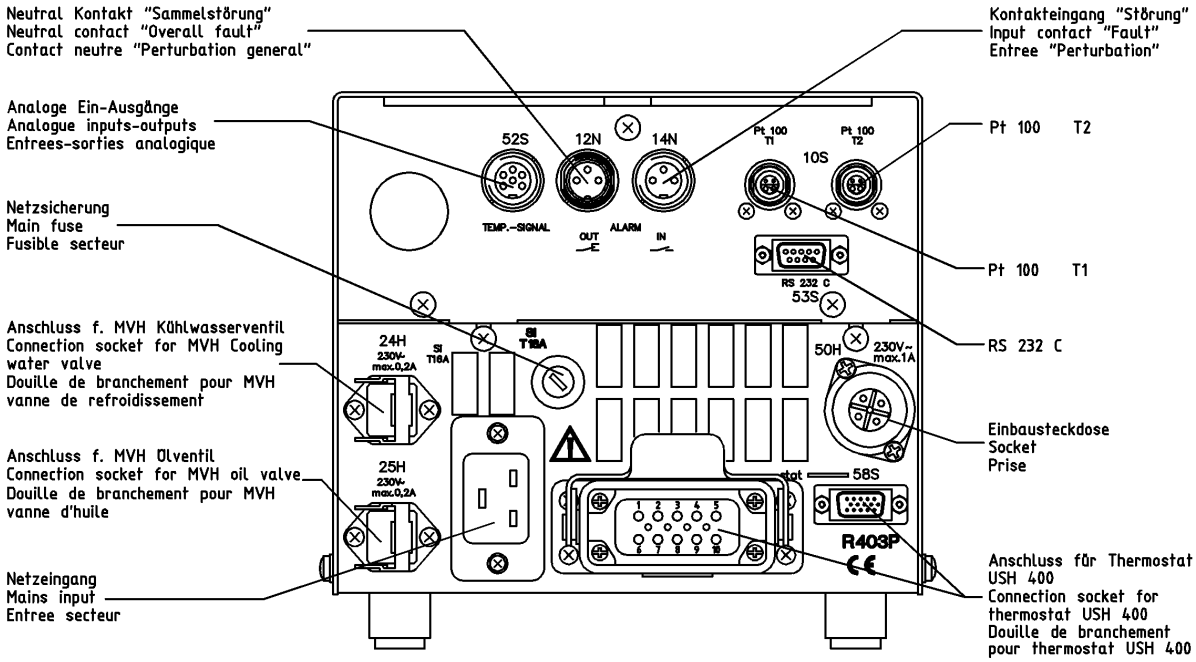
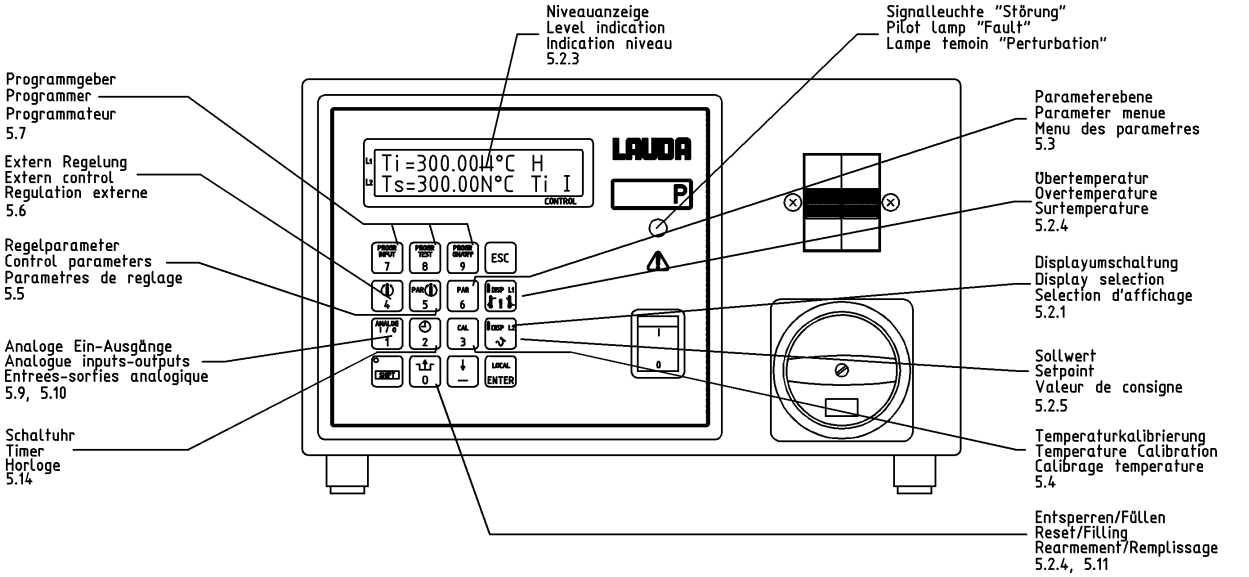
P
CONTROL
ESC
SHIFT
LOCAL
ENTER


Neutral Kontakt "Sammelstörung"
Neutral contact "Overall fault"
Contact neutre "Perturbation general"
Kontakteingang "Störung"
Input contact "Fault"
Entree "Perturbation"
Analoge Ein-Ausgänge
Analogue inputs-outputs
Entrees-sorties analogique
Pt 100 T2
Netzsicherung
Main fuse
Fusible secteur
Pt 100 T1
RS 232 C
Anschluss f. MVH Kühlwasserventil
Connection socket for MVH Cooling water valve
Douille de branchement pour MVH vanne de refroidissement
Einbausteckdose
Socket
Prise
Anschluss f. MVH Ölventil
Connection socket for MVH oil valve
Douille de branchement pour MVH vanne d'huile
Netzeingang
Mains input
Entree secteur
Anschluss für Thermostat USH 400
Connection socket for thermostat USH 400
Douille de branchement pour thermostat USH 400
52S
12N
14N
10S
53S
24H
25H
50H
58S
R403P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Pilot lamp "Fault"
Lampe temoin "Perturbation"
Programmgeber
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Programmateur
5.7
Extern Regelung
Extern control
Regulation externe
5.6
Regelparameter
Control parameters
Parametres de reglage
5.5
Analoge Ein-Ausgänge
Analogue inputs-outputs
Entrees-sorties analogique
5.9, 5.10
Schaltuhr
Timer
Horloge
5.14
Ti=300.004°C H
Ts=300.00N°C Ti I
CONTROL
LAUDA
ESC
LOCAL
ENTER
Parameterebene
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Menu des parametres
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Overtemperature
Surtemperature
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Display selection
Selection d'affichage
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Sollwert
Setpoint
Valeur de consigne
5.2.5
Temperaturkalibrierung
Temperature Calibration
Calibrage temperature
5.4
Entsperren/Füllen
Reset/Filling
Rearmement/Remplissage
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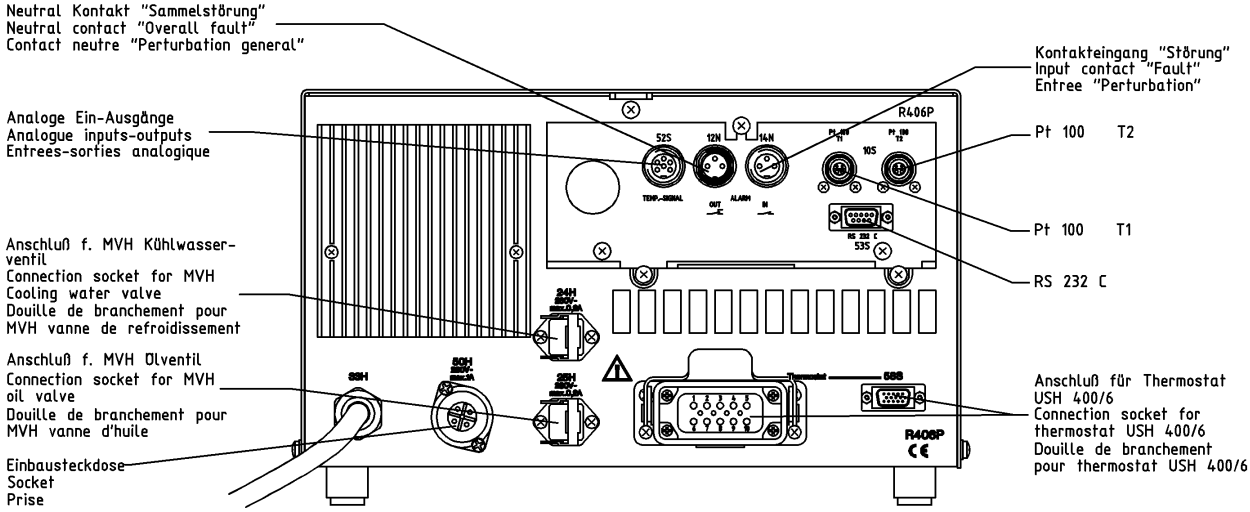
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Analoge Ein-Ausgänge
Analogue inputs-outputs
Entrees-sorties analogique
Anschluß f. MVH Kühlwasser-
ventil
Connection socket for MVH
Cooling water valve
Douille de branchement pour
MVH vanne de refroidissement
Anschluß f. MVH Ölventil
Connection socket for MVH
oil valve
Douille de branchement pour
MVH vanne d'huile
Einbausteckdose
Socket
Prise
Kontakteingang "Störung"
Input contact "Fault"
Entree "Perturbation"
Pt 100 T2
Pt 100 T1
RS 232 C
Anschluß für Thermostat
USH 400/6
Connection socket for
thermostat USH 400/6
Douille de branchement
pour thermostat USH 400/6
R406P
52S
12N
14N
10S
53S
58S
24H
30H
35H

2 Safety devices and warning notes

2.1 Operating safety

The units are fitted with an adjustable overtemperature protection as well as a low-level protection. The liquid at the operating temperature is not in contact with atmospheric oxygen as the expansion vessel ensures an intermediate stationary blanket of cold oil. When the unit is operated according to these instructions the surface of the used heat carrier liquid reaches temperatures of more than 25°C below the flash point. Thus the thermostat corresponds to EN 61010-02-010.

2.2 Why can a thermostat be dangerous?

1. Thermostats are equipped with heaters supplying the necessary heat to the thermostating liquid. If the temperature control fails or if the liquid level is too low, the heater may reach temperatures which can lead to a fire in the laboratory, especially in combination with flammable liquids.

2. When using the thermostat as a circulation thermostat a hose may break, causing hot liquid to spill and endangering people and goods.

   The safety requirements on thermostats therefore depend on whether

- non-flammable or flammable liquids are used

- operation is with or without supervision

The thermostats described in these Operating Instructions are protected against overtemperature and low liquid level when operated according to the regulations(FL).

The units can be operated with non-flammable bath liquids and with flammable bath liquids up to 25°C below their fire point (EN 61010) on condition that there is a correct adjustment and regular testing (see Item 5.12) of the overtemperature and low-level protection.

2.3 Important notes

The user is only protected against those hazards which are caused by exceeding the temperature and by low liquid level.

Further hazards may arise from the type of product being thermostated, e.g. a shift above or below certain temperature levels or a fracture of the container and a reaction with the thermostatic liquid, etc.

It is impossible to cover all possible causes, and they remain largely within the decision and responsibility of the user.

Values for temperature variation and indication accuracy apply under normal conditions according to DIN 58966. In special cases high-frequency electromagnetic fields may lead to less favourable values. There is no loss of safety.

Warning: The units must only be used according to the descriptions indicated in these Operating Instructions.

This includes operation by properly qualified and instructed personnel.

The units are not designed for operation under medical conditions according to EN 60601-1 or IEC 601-1!

2.4 Warning notes

Parts of the bath cover may reach temperatures above 70°C! The outflow and return pipes of the pumps reach the operating temperature. Touching them is dangerous because of very high or low temperatures!!

The unit must only be filled through the filler pipe (27) using the funnel supplied. This is necessary to ensure the preferential filling of the thermostating tank. Then run the unit at the operation "Filling" (see Item 5.2.3) until all air is purged.

No water, nitrogen or compressed air must be connected to any of the connections with M 16 x 1 thread. Connect water or gaseous coolants only to the cooling chamber connections (3) with M 14 x 1.5 thread. The maximum permitted pressure in the cooling chamber is 3 bar. The outlet must not be lockable.

Before starting up, check that all unused connections which carry an M 16 x 1 thread (except overflow) are closed with blind caps and screw cap.

Depending on the bath liquid used and the operating method there is a possiblity that toxic vapours may be produced. In that case it is necessary to provide an appropriate fume extraction. Pull out the mains plug before cleaning the bath with solvents. Provide the appropriate fume extraction. Before starting up the unit it is absolutely essential to ensure that the bath contains no explosive mixtures. If necessary purge it with nitrogen!

Mains cables and control cables must not come into contact with pump connections and hot surfaces! In case of damaged cables or any extension of the control cables the unit must be opened by a qualified electrician only! Use only original control cables from the manufacturer.

3 General construction and technical description

3.1 Application

The high-temperature thermostats USH 400 and USH 400/6 are intended for the use as circulation thermostats for thermostating closed external systems.
The design permits the operation at outflow temperatures up to 400°C when using suitable liquids. Connecting a heat exchanger to cool the liquid enables the abstraction of energy, and temperatures down to 20°C can be reached.

3.2 Construction

The unit consists of a thermostating tank (21) fitted with the functional elements such as heater (22), pump (19) and temperature probes (10), (20). The pump shaft (15) is inserted into this tank from the top through a sleeve without guide. The gap between the shaft and sleeve also serves as a connection between the thermostating tank and the expansion vessel (7) for the liquid interchange.
The thermal break between the thermostating tank and the expansion vessel is provided by thermal insulation, an air gap and a cooling chamber (17) through which the floor of the expansion vessel may be cooled with compressed air, nitrogen, oil or water if required.
The liquid level in the expansion vessel is sensed by a float (16) with a digital transmitter and indicated on the R 403 PL/R 406 PL control unit.
The pump motor (13) and the electrical termination chambers (14) are arranged above the expansion vessel.
All parts in contact with the liquid are made from rust-free stainless steel or from a material well-suited to the used heat transfer fluid.

Most of the electrical and electronic units of the controller, the safety devices etc. are arranged in a separate control unit R 403 PL/R406 PL which also contains all electrical operating and indicating elements.

3.3 Operating and functional elements (thermostat)

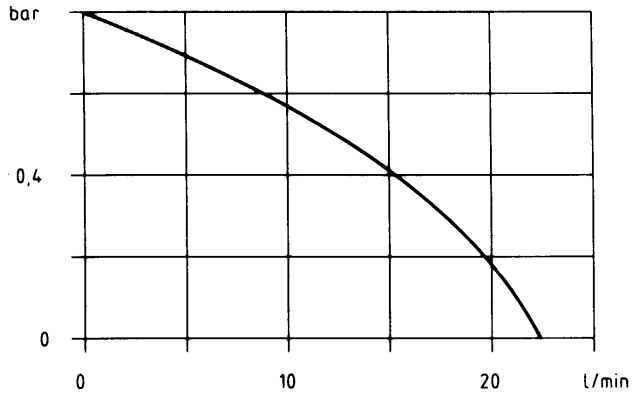
3.3.1 Thermostating tank

The thermostating tank (21) is completely filled with liquid during operation. The sealing against the top is provided by a flange with a special seal (18). The space between the thermostatic tank and the casing as well as above the flange is filled with a mineral insulation as a thermal break (8), (11). The unit is charged directly into the thermostatic tank through a special filler tube (27) taken out at the top. A drain cock (23) is provided which can only be operated with a tool (spanner 8 mm a/f).

3.3.2 Pump

The units are fitted with a 2-stage centrifugal submersible pump (15) (19), driven by an induction motor (13) with external rotor.
The pump operates up to a liquid viscosity of 150 mm2/sec. The motor winding is fitted with an overtemperature cut-out. A part of the pump output always passes over the heater independently of the external circuits. Two outflow connections (4), (9) together with the corresponding return connections (5), (26) are available for external circuits. A connection (30) is provided for an automatic vent valve available as an accessory. The vented side of the valve leads through the connection (28) into the expansion vessel.

Pump characteristics:



measured with water

3.3.3 Heater

Two tubular heaters (22) are located in the lower part of the thermostating tank in order to achieve the lowest possible loading of the heater surface. The heaters are arranged so as to achieve a directed uniform circulation around them.

The type USH 400 has a heating output of 3 kW. The type USH 400/6 provides 5.6 kW heating output with almost twice the loading of the heater surface.

3.3.4 Temperature probe

A temperature probe (20) is immersed in the thermostating tank for measurement and control and so is another probe (10) for the separate safety circuit which is also used to sense the temperature of the heater surface.

3.3.5 Expansion vessel

The expansion vessel (7) is linked to the thermostating tank through the annular gap around the pump shaft (15). The bottom of the expansion vessel is arranged as a cooling chamber (17); a coolant can be passed through it by the connections (3) (M 14 x 15). A minimum liquid level in the expansion vessel assures that the liquid in the thermostating tank is always blanketed by cold oil to prevent contact between the hot liquid and atmospheric oxygen.

The liquid level in the expansion vessel is monitored by a float (16) and digitised through a magnetic probe with Hall sensors. An additional expansion vessel of approx. 1 l volume can be attached through the connecting sleeve (25) if necessary.
In addition there is an olive (10 mm ext. diameter) at the top end of the expansion vessel as an inert gas connection (6), and a connection piece with olive (13 mm ext. diameter) as overflow (1).
The back of the unit carries a heavy strap (2) with two threaded holes (M 10) for mounting the unit on a laboratory wall.

3.3.6 Motor chamber

The motor chamber (14) takes the control cable connections, the level sensor electronics, as well as the pump motor with fan, separated from the rest by the air guide; it draws air from below the noise cover and blows it out in a downward direction above the expansion vessel.
By removing the housing all functional elements are accessible. The connection terminals for the control cable can easily be reached, e.g. for connecting a longer cable. (Warning: only to be done by a qualified electrician.).

3.3.7 Controlled cooler MVH

For automatic cooling the thermostat USH 400 can be equipped with a controlled cooler MVH. The MVH is supplied with the heat carrier liquid by one pair of the pump connections. Then the unit can be operated with water cooling within the total operating temperature range. The control electronics for both solenoid valves (oil, water) is installed in the controller R 403 PL/ R 406 PL as standard equipment.

3.4 Operating and functional elements of the R 403 PL/R 406 PL

The entire electronics and the corresponding operating elements for temperature indication and setting as well as safety functions are housed in a separate unit, the controller R 403 PL/ R 406 PL. The connection to the thermostat is done by two special cables (24, 24a). In case of repair it is essential to use only the original cables and the original connectors in order to ensure electrical safety.
The thermostat USH 400 can only be operated with the controller R 403 PL. The type USH 400/6 has to be operated with the controller R 406 PL. A different combination is not serviceable but also does not cause any dangers!
The separation of the thermostat and the controller permits remote operation of the unit, e.g. the thermostat can be placed inside a fume cupboard and the control unit outside.

3.4.1 Control

The units employ a Pt 100 resistance thermometer for measuring the bath temperature (Ti). The bath temperature, all other temperature values and message signals as well as inputs are indicated as 2 x 16 characters 10 mm high on a liquid crystal display (LCD) with background illumination. Input of the setpoint (TS) and all other parameters is done by using a membrane keypad with 16 keys and operator guidance by the LCD display field. All inputs are stored even when the thermostat is switched off or if the supply fails.

Digitisation of the Pt 100 resistance signal is performed in the microprocessor by continuous comparison with precision resistors. The following control using a modified PID control algorithms is purely digital. The tubular heater for the bath heating is operated completely electronically using a triac with burst firing action.

The description of further functions is done in Item 5 starting up.

4 Unpacking, assembly and setting up

4.1 Unpacking

Goods are packed carefully, largely preventing transport damage. If unexpectedly some damage is visible on the equipment, the carrier, the post office or the railway has to be informed in order to inspect the damage.

Standard accessories:

Thermostat USH 400 / USH 400/6

1	Filler funnel	Cat.-No. UD 259
8	Screw caps M 16 x 1	Cat.-No. HKM 032
7	Blind caps	Cat.-No. HKN 065
1	Olive 13 Ø (for overflow)	Cat.-No. HKO 026
2	Olives 13 Ø (for cooling chamber, M 14 x 1,5)	Cat.-No. HKA 110

Control and operating element R 403 PL (USH 400)

1	Mains connection cable	Cat.-No. UK 089

Control and operating element R 406 PL(USH 400/6)

without accessories

Operation instructions

4.2 USH 400 - USH 400/6

4.2.1 USH 400 (3 kW heating)

Place the thermostat and the controller R 403 PL next to each other. Attach the control connection to the sockets 41 H and 58 S while the equipment is switched off.
Plug in the mains plug (12 H).

4.2.2 USH 400/6 (5,6 kW heating)

Place the thermostat and the controller R 406 PL next to each other. Make the connection to sockets 42 H and 58 S.

Only combine USH 400 with R 403 PL or USH 400/6 with R 406 PL. A different combination is not serviceable but does not cause any dangers!

Note: Mains cable and control cable must neither have contact to the pump connections nor to the outer housing! Damaged cables must be replaced by a qualified electrician immediately. Otherwise electrical safety is no longer ensured!

4.3 Connection of external systems

Only pressure tight systems can be connected. Use metal tubes according to Item 6.2. only.

Note: When tightening the screw caps (19 mm a/f) at the tubing connections, hold the threaded nipple with a spanner (14 mm)!

With external systems positioned at a high level it may happen even in closed circuits that the external volume drains down and the thermostat tank overflows if the pump is stopped and air enters the thermostated system!

Always ensure the maximum possible flow area in the external circuit (nipples, tubing, system). This results in a larger flow and therefore an improved thermostatic control.

4.4 Cold oil blanket and extra functions

Depending on the operating temperature it may be necessary to provide cooling for the bottom of the expansion vessel (3).
Up to 250°C operating temperature no cooling is necessary to keep the temperature in the expansion vessel below 100°C; above this operating temperature, cooling with compressed air, nitrogen or water should be provided. It is important that the water flow already starts at a liquid outlet temperature below 200°C; otherwise rapid temperature changes may cause problems.
In general it is possible to avoid water cooling when working with compressed air or nitrogen.

Recommended flow rates:

Compressed air, nitrogen	approx. 200	L./min.
Water	approx. 1	L./min

Note: The max. pressure in the cooling chamber is 3 bar!

Screw filler funnel on filler tube (27).

If necessary connect inert gas to olive (6) in order to blanket the heat carrier liquid in the expansion vessel.

With larger expansion volume, connect tubing from collecting vessel (1) to overflow.
It is preferable to employ an optional extra expansion vessel (Cat. No. UD 260) which is mounted on the connection (25).

Note: Do not shut the expansion vessel tightly!

With frequent changes of external systems positioned at a high level, it is advisable to use the automatic vent valve (Cat. No. UD 253) available as accessory. This speeds up and simplifies the purging of the system.
Connect the vent valve (29) at the connections (30) and (28).

5 Starting up

5.1 Connection to supply

Compare the details on the label of the thermostat as well as the controller with the mains voltage and frequency!

Model according to EMC directive EN 61326-1 (industrial areas only). *

Check that all not required connections - except overflow (1) and inert gas (6) - are blanked off with blind caps.

USH 400 (3 kW heating)

A mains supply with earthed contact (PE), fused at 16 A, is required for units protection class 1!
Plug in mains plug. Operate mains switch. Green lamp in the mains switch lights up.

USH 400/6 (5,6 kW heating)

It is necessary to have a 230/400 V; 3/N/PE three phase current connection fused with 16 A.

Plug in mains plug. Operate main switch (red/yellow) and mains switch (green). The green indicating lamp lights up.

5.2 Basic functions

5.2.1 Display

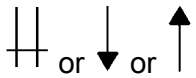
The display shows consecutively:

Fa. LAUDA P-Thermostat	
Type R 403 P V 2.XX Date	Type Software version
L1 Ti = 20,00°C C L2 TS = 10,00°C L Ti I	other values depending on bath temperature and setpoint

* Notice only valid for EU countries!

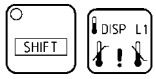
Standard display

Top line L1

Ti	=	bath temperature (i = internal)
	=	level indication in expansion vessel
C	=	output in cooling range
H	=	output in heating range
TA	=	Warning indication for motor chamber temperature
	=	cooling indication proportional to cooling actuation control
	=	heating indication proportional to heating actuation control

Bottom line L2

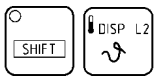
TS	=	Setpoint temperature (S = Setpoint)
Ti	=	control variable is Ti (bath temperature), can be switched to T1 or T2 (ext. Pt 100)
L	=	Remark that level indication is activated in above digit at line L1
N	=	notice that the level indication acts in the top line L1
I	=	setpoint source (I = Internal = input by keys, P = Programmer, R = RS 232 C, A = Analogue input socket 52 S)

The display in line 1 (L1) can be switched by pressing the keys 

and repeated operation of

to T1, T2, Ti etc.

T1, T2 = measurement results of the external Pt 100 probes

The display in line 2 (L2) can be switched by pressing the keys 

and repeated operation of

to

Y = actual output + heating - cooling

TSi = measurement result of the safety comparison probe with limited resolution and accuracy

Ti, T1, T2, TS etc.

5.2.2 Basic action on input and output

From virtually every display or input function, the

key aborts and returns to the selected standard display!

Numerical inputs are always done with the SHIFT function switched off (LED in SHIFT key OFF) !

After the last digit of a number the cursor returns to the first digit so that corrections can easily be made before pressing the

key.

A brief beep on pressing a key means that this input is not possible!

Error messages are indicated with text notes, accompanied by a beep. After approx. 5 sec the message disappears and the beep is switched off!

5.2.3 Automatic filling and level indication

Proceed with starting up as described in Item 5.1 but without heat carrier liquid filling. The error message appears

L1 Level

L2 TOO LOW

und there is a beep.

Press the key one time.

On the display appears:

L1 Filling N .

Fill in heat carrier liquid by means of the filler funnel. The arrow in the level indication disappears and the liquid level is indicated by the symbol.

The height of the cross bar gives an information about the actual level within the expansion vessel; the vertical bars indicate the expansion range. After having reached position 3 from the bottom the pump is switched on; during operation "Filling" the heater is always switched off!

The external system is filled; the liquid level drops until the pump is switched off again and the symbol is shown on the display (arrow down = fill in liquid!).

Fill in as much liquid to reach a liquid level indication as low as possible; at this level the maximum volume for expansion is at your disposal and the pump is running. Make sure that the circuit is deaerated by running the unit for some minutes.
Unscrew filling funnel and close filling connection by blind cap.

Leave operation mode "Filling" by pressing . The unit now works at normal operation. A beep can be heard in short intervals if the symbol = Fill in liquid appears on the display.

If the liquid level keeps on dropping, the heater and the pump are switched off (see Item 2.2). The display means, that there is the risk of overflow in the expansion vessel and the heater is switched off!

5.2.4 Overtemperature switch-off point

Press the key to indicate the current overtemperature switch-off point (TO).

Important: The green LED in the key must not be alight. If necessary bring the keypad to the basic mode by pressing the key (LED OFF). If TU is indicated, press again to indicate TO.

L2 TO: _95.00 Ti I

TO = overtemperature switch-off point

TO can be selected within the unit temperature range + 5 K.

Return to the standard display without change with ESC. A new value is input with the number keys (SHIFT OFF); e.g. 98.70°C requires 0, 9, 8, 7, 0 LOCAL ENTER. After the last digit the cursor returns to the first digit again so that any corrections can easily be made.
Pressing LOCAL ENTER always enters the value on the display.

Pressing the key LOCAL ENTER Enter you are asked

L2 To new Y/N 1/0__(0)

Here the changed value must be confirmed with input ANALOG I/O 1 or, if no modification is requested, the initial value can be unscrambled again with input 0. As default value 0 is preset.
This interrogation was introduced in order to reach an additional protection from unintentional adjusting of the over-temperature switch-off point..

It is obviously essential to select a value above the current bath temperature (Ti) and the current setpoint (TS), otherwise the equipment is switched off by the safety circuit with

L1 TEMPERATURE

L2 TOO HIGH!

or the message

L2 TS: >> TO

and the value is not accepted.

With activated outflow temperature limit Tio To must always be 5°C higher than Tio. Otherwise announcement

Tio >> to –5°C

If the unit has been switched off in the fault status an audible signal reports the stored fault when switching on.

Press the reset key 0. Depending on the previous sequence press 0 again.

If necessary check whether the overtemperature switch-off point TO is above the current bath temperature and whether the bath is filled sufficiently!

5.2.5 Low temperature switch-off point

Press

(SHIFT OFF) to indicate the current low temperature switch-off point TU. If TO is indicated, press the

key again to bring TU on display.

L2 TU: _-10.00°C

TU = low temperature switch-off point

TU can be set up to 10 K below the working temperature range of the unit.

If the bath temperature falls below TU, TU appears on the display in L2 so that a new value can be input if necessary. TU can be used as setpoint limitation!

5.2.6 Setpoint input

Press the

key (SHIFT LED OFF). L2 shows

L2 TS: _ 20.00°C Ti I

The setpoint (TS) can be input within the unit temperature range but not higher than the current overtemperature switch-off point. When the input is too high, pressing

does not enter the value but instead the message

L2 TS >> TO

appears.

Input TS with number keys incl. negative sign (SHIFT OFF), e.g. for -25.03°C input -, 2, 5, 0, 3

. Or for 1.93°C input 0, 0, 1, 9, 3. After the last digit the cursor returns to the first digit again so that corrections can easily be made.

5.2.7 Heating up

The unit is equipped with an automatic limitation of the heater surface temperature being always in function. If the probe for safety temperature control coupled to the heater surface monitors a temperature of more than 9K above bath temperature the heater is switched off; it is switched on again at a temperature of about 7K above.

They display accordingly shows .

This function prevents the heat carrier liquid from high film temperatures during heating up at higher viscosities. When refilling, outgas or heat up the heat carrier liquid according to Item 6.1!

5.2.8 Warning indication for motor chamber temperature

If TA appears in line L1 (see Item 5.2.1), the unit indicates that the temperature of the pump motor chamber is above approx. 55°C At the same time an audible alarm signal can be heard. If the temperature continues to rise and reaches temperatures above 65°C, the heater is switched off. If the temperature drops below approx. 58°C, the heater is switched on again. The temperature of the motor chamber depends on the ambient temperature, operating temperature of the heat carrier, pump load and the cooling of the expansion vessel!

5.3 Parameter level PAR

Pressing the PAR 6 key several times in the SHIFT mode (green LED in SHIFT key alight) leads successively to the input functions described below.

5.3.1 Auto-adaptation

Here it is possible to start controller auto-adaptation by input of 1 (SHIFT OFF) and pressing the LOCAL ENTER key.

There should be the largest possible difference between the bath temperature and the setpoint to be entered subsequently, i.e. the time to reach the setpoint must be longer than 5 min, and preferably 10 min. In addition, auto-adaptation is obviously possible only during a heating or cooling phase which is actively influenced by the energy sources available.

Example: Intended operating temperature approx. 200°C

1. Set setpoint to 200°C
2. Within 1 minute start auto-adaptation at the PAR level, e.g. at a bath temperature corresponding to the ambient temperature

On reaching the setpoint the auto-adaptation switches off automatically and the result of auto-adaptation can be indicated at the control parameter level PAR 5 (see Item 5.4).

5.3.2 Output limitation

Normally the maximum heating or cooling output is available. For special applications it is possible to set a limit for both heating and cooling output.

At the PAR level display select

L1 Output

L2 in per cent_ 100 %

Using ↓ — the display can be switched from e.g. 100%, i.e. heating output limitation, to cooling output limitation with a negative sign.

By the input of e.g. 0, 0, 5, 8 LOCAL ENTER, SHIFT OFF, a heating output limitation of 58% can be set.

With e.g. -, 0, 9, 3 LOCAL ENTER a cooling output limitation of 93% is entered.

The action can be recognised by the symbols and flashing even with large control deviations.

Only values between 10 and 100% or -10 and -100% can be entered, otherwise the display shows the message

L1 Output

L2 OUT OF RANGE

5.3.3 Display resolution L1

At the PAR level display select

L1 Display 0.001 = 1

L2 resolution 0.01 = 0

Enter 1 SHIFT OFF, LOCAL ENTER. Switches all displays in L1 to 0.001 K resolution. The temperatures are then displayed with approx. 2 digit resolution. Input "0" switches all the displays in L1 to 0.01 K resolution.

Normally a resolution of 0.01 K is used.

5.3.4 Contact input fault 14 N (alarm in)

By the Contact input fault 14 N (alarm in**)** the safety switch-off of the unit USH 400 can be activated from an external signal.

Connections contact input "Fault" 14 N (alarm in):

3-pin flange socket accord. to NAMUR recommendation NE 28

1 = n.o. (close)
2 = common
3 = not used

Connector plug 3-pin Cat. No. EQS 048

Use shielded connecting cables. Connect shielding to plug case. Cover the unused connectors with protective caps!

Contact load approx. 5 V 2 mA. No voltage must be connected!

When using the contact input "FAULT" 14 N, pins 1 and 2 of the socket have to be connected together when there is no fault. If this input is not being used, a blanking plug with a link must be plugged in. The function of the contact input fault can be switched off at the PAR level on the display

L1 Alarm Inp. con 14 N

L2 on = 1 off = 0

by the input of "0" (SHIFT OFF). A shorting plug is then not required.

If the alarm input has been activated in error by the input of "1", the unit can be restarted by the following inputs:

Press the 0 key. Select "Alarm Inp. con 14 N" at the PAR level. Input "0" with LOCAL ENTER. Press 0 again.

If a fault message has been produced by opening the external signal circuit, reset by pressing the 0 key twice after rectifying the fault.

5.3.5 Baud rate RS 232

On the display at the PAR level

L1 Ser. Int RS 232

L2 Baud Rate 9600

it is possible to switch with ↓ — between 9600 and 4800. With LOCAL ENTER (SHIFT OFF) the indicated baud rate is entered.

5.3.6 Menu language

On the display at the PAR level

L1 Lang. Germ = 0

L2 Engl = 1 French = 2

the menu language can be selected. Enter the corresponding code numbers 0, 1 or 2 with LOCAL ENTER on SHIFT OFF.

5.3.7 Calibrating the analogue output channels

The 90% values of the analogue voltage outputs channels 1 and 2 or the analogue current output of channel 1 can be calibrated separately for channel 1 (voltage or current) and channel 2 (voltage). The factory calibration on channels 1 and 2 for 0...10 V = -100...400°C is performed at 9 V = 350°C.

In special cases, e.g. to correct scaling deviations of instruments connected to the output, or if channel 1 is to be a current output, the output can be calibrated by the user.

At the PAR level display select

L1 Analogue outp Cal ?

L2 Chan 1 = 1 Chan 2 = 2

Input SHIFT OFF 1 [LOCAL ENTER], or 2 for channel 2.

Depending on the selected configuration of the analogue outputs (see Item 5.8) the socket 52 S carries a voltage signal of approx. 95% or 9.5 V, or pin 5 the corresponding current signal of approx. 19 mA in case of current configuration for channel 1.

Using a precision multimeter or e.g. a temperature recorder set the output signal to 9 V or 18 mA or the corresponding temperature by repeated operation of the [↓ −] key (SHIFT ON).

The output signal decreases by one level each time a key is pressed.

Pressing [ESC] leaves the menu and the most recent value setting is entered.

If the value was selected too low, leave the PAR level with [ESC] and make a new selection.

Calibration of channel 2 is similar. Connect the measuring instrument to pin 1 (voltage signal only).

5.4 Calibration of the temperature measurement circuits

With the calibration function the indications of the three temperature measuring points bath temperature T_i, external Pt 100 probe T_1 and external Pt 100 probe T_2 can be set to a known accurate value. The resulting correction is processed additively over the entire temperature range.

Check first that a sufficiently accurate reference is available, otherwise it is better to use the factory calibration which gets lost by overwriting!

Pressing the key [CAL 3] in the SHIFT mode (green LED in shift key alight) produces the display

L1 CALIBRATE

L2 T_i = 0 T_1 = 1 T_2 = 2

The channel to be calibrated is selected with 0, 1 or 2 [LOCAL ENTER].

When selecting an unused channel, e.g. Pt 100 on T_2 not connected to T_2 the display shows

L1 Ext Pt 100 not

L2 connected.

For calibration a sufficiently accurate reference temperature measurement should be possible, and the measurement point temperature should be constant.

The display shows

L1 T_1 61,04°C

L2 T_C _ . °C

The value shown in L1 is the measured value obtained without any correction using probe and electronics without calibration.

Now enter the real value for measurement point T_1 (e.g. 60.00°C).

Example 0, 6, 0, 0, 0 [LOCAL ENTER]

T_i or T_2 can be calibrated in the same way.

In order to avoid dangerous conditions the correction is limited to ±5 K. In case of larger corrections the display shows

L1 CORRECTION VALUE

L2 TOO LARGE

and the entered value is not accepted.

You can leave the calibration level with [ESC].

5.5 Control parameters

5.5.1 Indication and input of the control parameters

Pressing the [PAR 5] key several times in the SHIFT mode (green LED in shift key alight) shows the outflow temperature limitation, the correction limitation and the control parameters X_p, T_n and T_v on the display in L2.

Example:

L2	Tio	120°C	Ti	I
L2	Td	_30°C	Ti	I
L2	Xp: _	0,5°C	Ti	I
L2	Tn: _	12.0 s	Ti	I
L2	Tv: _	2.0 s	Ti	I

In order to use control parameters other than those found by auto-adaptation (see Item 5.3.1) the values can be entered in the appropriate display after switching off the SHIFT function, pressing

, LED OFF.

Example for Xp

0, 0, 1, 0

if the required value is 1.0°C.

For values above 200.0°C or 200.0 sec the message

L2 OUT OF RANGE

appears.

5.5.2 Recommendations for the control parameters

In most cases satisfactory control results are obtained with the following control parameters:

	USH 400	USH 400/6
Xp	2°C	3°C
Tn	25 s	25 s
Tv	5 s	5 s

5.5.3 Bath temperature limitation

The limitation of the bath temperature is an additional warning and switch-off function switching off the heating at a selectable value, i.e. the heating output is set to "0". This protects the unit from a continuous cut-off via the safety circuit especially during external control at certain operating conditions.

To enter the switch-off point Tio proceed as described in Item 5.5.1 and switch the display to input and indication.

Example:

L2 TiO 120°C

Change the value by entering the figures with a resolution of 1°C.

Enter the new value by pressing LOCAL ENTER.

It is possible to select values within a range from 50°C to the selected overtemperature switch-off point TO - 5°C. If this range has not been respected the display shows the message

L2 TiO >> TO - 5°C

Of course TiO has to be set above the setpoint TS; otherwise the display shows the message

L2 TS > TiO

The bath temperature limitation can be switched off by entering

L2 TiO 000

If the bath temperature Ti exceeds the selected switch-off point the display shows

Example:
L2 TiO 120°C

and there is an acoustic signal.

The heater switches off. As soon as the temperature has dropped the unit starts working again.

5.5.4 Correction limitation

During the operation with external control it may be necessary not to exceed the difference between the bath temperature Ti and the measuring point for the external control T1 or T2, e.g. in order to get a smooth heating of the material or the vessel.

Such a limit value can be selected by the variable Td. If the value Td is exceeded the heating or cooling output is set to "0".
If this function is activated the time for heating up or cooling down may be extended.

To enter the difference value Td proceed as described in Item 5.5.1, and switch the display to input and indication.

Example:
L2 Td _30°C

Change the value by entering the figures with a resolution of 1°C.

Enter the new value by pressing LOCAL ENTER.

It is possible to select values within the temperature range from 5°C to 150°C. If this range has not been respected the display shows

L2 OUT OF RANGE

and there is an acoustic signal.

This function can be switched off by entering

L2 Td 000°C

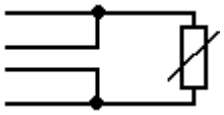
The fixed correction limit at 25°C as described in Item 5.6.2. is set out of function as soon as the above mentioned function has been entered.

5.6 External measurement inputs and external controller

The units have two Pt 100 temperature measurement inputs whose measurements can be indicated (T1, T2).
You can connect an external Pt 100 (T1, T2) at the rear connectors 10 S in 4-wire circuit.

Pin connections sockets 10 S Pt 100

pin			
1	+	I	current path
2	+	U	voltage path
3	-	U	voltage path
4	-	I	current path



Pt 100
DIN IEC 751

Plug, 4-pin, Lemosa, for Pt 100 connection Cat. No. EQS 022

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

One probe can be selected for the actual value for external control. The unit then operates with cascade control to this actual value, i.e. the unit controls the temperature at the external measurement point to the selected setpoint by suitably altering the bath temperature.
Thus the influence of disturbance (changes of load or through-flow, etc.) can be reduced considerably or eliminated totally.

5.6.1 Start of external control

Connect platinum resistance thermometers to both of the Pt 100 inputs 10 S (T1 and T2). It is sensible but not essential to use T1 if only one input is in use.

The external control using the measuring point T1 is switched on with the

key in the SHIFT mode; pressing the key again switches to T2 as control variable.

Pressing the

key once more (SHIFT ON) switches back to the bath control (internal) Ti.

In L2 the position before the final one shows the parameter used as control variable.

L2	TS	= 120.35	Ti	I
			T1	
			T2	

This setting remains stored in case of a fault or after the power is switched off.

If T1 is selected but no probe has been connected the message

L1 Ext Pt 100 not

L2 connected

appears.

The unit then switches the control variable to T2 automatically. If T2 is also not connected, the thermostat switches to Ti.

When changing the setpoint for more than 10°C it may be possible to achieve an improved control result by restarting the external control from the control variable Ti (with SHIFT).

After power OFF the unit operates with control from the bath (Ti) for safety reasons; external control must be re-selected after power ON as explained above.

5.6.2 Notes

When operating with external control it is essential to ensure that the probe for the control variable is in good thermal contact with the liquid, otherwise a poor control result must be expected or the control may be completely ineffective.
Proceeding from the control parameters used for bath control the control may have to be adapted either by auto-adaptation (see Item 5.3.1) or by the input of the control parameters.

Important: Set the overtemperature switch-off point TO (see Item 5.2.4) sufficiently high since the bath temperature may under certain circumstances become much higher than the setpoint.

5.7 Operation with programmer

Temperature programmes with up to 99 segments can be stored and processed.

A segment consists of a target temperature which is to be reached at the end of the segment, and the time duration of the segment.
The time "00:00" for temperature differences is possible. In connection with the tolerance range monitoring the programme continues not until the target temperature is reached.
It is useful to prepare a time-temperature diagram before programming and to check whether the energy balance enables the programme speed.

Set the overtemperature switch-off point TO to a value slightly above the highest bath temperature to be expected (see Item 5.2.4).

5.7.1 Programme input

Press the PROGR INPUT 7 key in SHIFT mode. The display shows

L1 PROG. INP

L2 Tstart:_ . °C

Enter here the starting temperature of the programme. SHIFT OFF (automatically), e.g. for 60.00°C input 0,6,0,0,0 LOCAL ENTER

The display shows

L1 PROG. INP SEG.01

L2 T:_ . °C : h

Now enter the target temperature and time for the first segment, e.g. for 140.00°C in the time 2 h 00 min

1, 4, 0, 0, 0 LOCAL ENTER, then 0, 2 LOCAL ENTER, then 0,0 LOCAL ENTER.

The display shows

L1 PROG. INP SEG.02

L2 T:_ . °C : h

Now enter the target temperature and the time for the second segment, e.g. for a phase at constant temperature 140.00°C and 1 h 30 min.

After the last programme segment press the LOCAL ENTER key once more and the display shows

L1 PROG. INP

L2 NO OF CYCLES:_

Input 1 ... 99 is possible.

With more than one cycle it is convenient to have the final temperature and the starting temperature Tstart at the same level!

Afterwards a tolerance range can be input for monitoring the programme.
The display shows

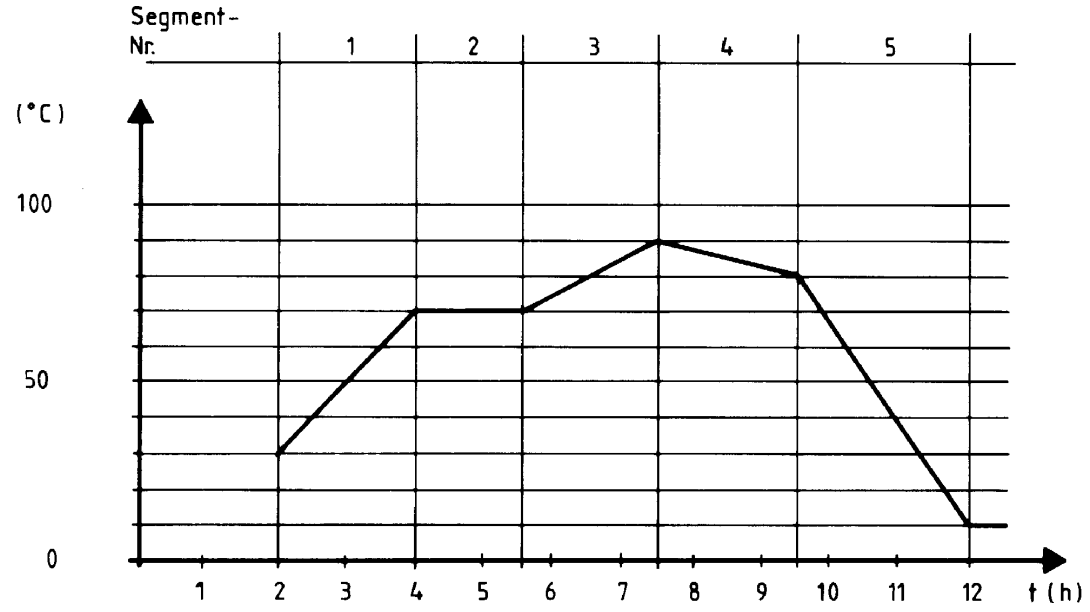
L1 PROG. INP

L2 TOL. RANGE_.

Now you can input a tolerance range value from 0.1 to 9.9 °C. I.e. if the control variable (bath temperature or external temperature T_1 or T_2) deviates from the set temperature of the segment by more than the tolerance range value while the programme is running, then the programme sequence will be stopped until the control variable is within the tolerance range again.
At the same time a "T" appears on the right in L_2.

The input of 0.0 switches off the tolerance range function.

5.7.2 Example of a programme



Segment-No.		Input	Press LOCAL ENTER
Tstart		03000	1x
1	°C	07000	1x
	h	02	1x
	min	00	1x
2	°C	07000	1x
	h	01	1x
	min	30	1x
3	°C	09000	1x
	h	02	1x
	min	00	1x
4	°C	08000	1x
	h	02	1x
	min	00	1x
5	°C	01000	1x
	h	02	1x
	min	30	2x
Cycles		1 ... 99	1x
Tolerance range	±°C	(0.0) 0.1 ... 9.9	1x

5.7.3 Programme test

After the input of the programme it is advisable to check that the programme buffer contains the correct data. This is done with the PROGR TEST 8 key in the SHIFT mode.

Pressing the key repeatedly produces the same sequence as during the input of the programme.

5.7.4 Changing the programme data

Select the data line to be changed as in "programme test", SHIFT OFF. This resets the data of the indicated segment. Then the data can be input as usual.

Enter the new data with LOCAL ENTER each.

5.7.5 Programme start, interruption and abort

It is useful to bring the operating temperature of the thermostat to the programme start temperature T_{start} before starting the programme or to automatize it by the tolerance range function.

Start the programme sequence with PROGR ON/OFF 9 in the SHIFT mode. The programme sequence can then be followed by the indication of the setpoint T_S.

L_1 shows the segment number on the right, and L_2 shows as setpoint source P for "programme" on the right.

The keys 1 to 9 are blocked while the programme is running.

The programme sequence can be stopped with SHIFT PROGR ON/OFF 9 and then be re-started with PROGR ON/OFF 9. During the interruption of the programme the display shows a W (wait) on the right in L_2.

The programme can be aborted with ESC and then SHIFT PROGR ON/OFF 9 within two seconds.

Afterwards the programme can only be started with segment 1.

5.8 Connection for analogue signal socket 52 S

6-pin flange socket according to NAMUR recommendation NE 28.

Pin 1: voltage output temperature signal channel 2: setpoint T_S, bath temperature T_i, external Pt 100 T_1 or T_2 can be selected. Scaling can be as follows:
0...10 V corresponding to a temperature range selected within the working temperature range (e.g. 50...80°C)
minimum load 4 kOhm
or
0...6 V = -200...400°C = 10 mV/K
0°C = 2 V
or
0...10 V = -100...400°C
or
0...10 V = 0...100°C

Pin 2: voltage output temperature signal channel 1, other data as pin 1

Pin 3: ground for all signals

Pin 4: setpoint voltage input; scaling can be selected as pin 1.
R_i = 12 kOhm approx. (+ pin 4; - pin 3)

Pin 5: current output temperature signal channel 1; signal selection as pin 1. Can be configured for 0...20 mA or 4...20 mA. Scaling can be:
0...20/4...20 mA = -100...400°C
or
0...20/4...20 mA = 0...100°C
or
0...20/4...20 mA = a temperature range selected within the working temperature range (e.g. 50...80°C)

maximum burden 330 Ohm

Connect only either pin 2 or pin 5!

Pin 6: setpoint current input; configuration and scaling as pin 5.

Burden 320 Ohm approx. Maximum voltage 15 V!

Connector plug, 6-pin Cat. No. EQS 057

Use shielded connecting cables. Connect the shielding to the plug case. The mass for all signals (pin 3) must not be connected with ground! If a connection to the ground cannot be avoided use a potential-free signal bridge in between.

Cover the unused connectors with protective caps!

5.9 Analogue inputs

A setpoint in the form of an analogue current or voltage signal can be provided by connection to the socket "Temp.-Signal" 52 S (see Item 5.8).

By pressing the [ANALOG I / O 1] key in the SHIFT mode the display shows

L1 ANALOGUE INP/OUTP

L2 INP = 0 OUTP = 1_

Pressing 0 [LOCAL ENTER] selects configuration and scaling of a setpoint input.

The display shows

L1 ANALOG INP. OFF = 0

L2 ON = 1 CONF = 2_

Input 1 [LOCAL ENTER] switches in a previously configured input as setpoint and L2 shows an "A" at the right end, indicating that the setpoint is determined by the analogue input.

This condition remains stored in case of a fault or after the power is switched off.

Input 0 [LOCAL ENTER] switches the setpoint back to setpoint source I internal, i.e. key input.

Scaling takes place interactively by applying the voltage and current values corresponding to the appropriate temperature range limits to the corresponding input.

For pin connections for voltage or current input on socket 52 S see Item 5.8. This method compensates for various scaling errors, e.g. also those of the sources connected.

Pressing 2 [LOCAL ENTER] configures and scales the setpoint input. The display shows

L1 ANALOG INPUT

L2 U = 0 I = 1

Select a voltage range with 0 [LOCAL ENTER]. Voltages in the range 0...10.5 V can be handled.

A current range is selected with 1 [LOCAL ENTER]. Currents in the range 0...22 mA can be handled.

The display shows

L1 ANALOG INPUT

L2 T_{min} = _ . °C

Input the lowest temperature of the range which corresponds to the lowest voltage or current value of the range to be scaled.

Example: range 0...120°C should correspond to 0...10 V approx.

Input 0, 0, 0, 0, 0 LOCAL ENTER.

The display shows

L1 ANALOG INPUT

L2 T_{max} = _ . °C

Input the upper limit of the temperature range

1, 2, 0, 0, 0 LOCAL ENTER

If current input is selected, the programme asks whether 0...20 mA or 4...20 mA is required.

The display shows

L1 CURRENT INPUT

L2 0-20 = 0 4-20 = 1

Select 0 LOCAL ENTER or 1 LOCAL ENTER. This menu item is omitted when voltage input has been selected.

The display shows

L1 INPUT CAL.?

L2 YES = 1 NO = 0

Here a decision is made whether an automatic calibration procedure is started or whether the voltage or current values from the last calibration procedure are retained

with input 0 LOCAL ENTER. The display returns to the standard display.

With a new calibration the voltage or current source (e.g. setpoint unit, programmer) has to be connected up. The range limits have to be adjustable.

The unit may switch to fault if the input signal is not connected. If this is the case it is necessary to connect the input signal first.

Then press the reset key 0 and calibrate in the same way as described above.

Select the recalibration with 1 LOCAL ENTER.

The display shows

L1 SET Umin

L2 YES = 1

When the voltage or current corresponding to the lower range limit is applied to the input, confirm this by input of 1 LOCAL ENTER.

The display shows

L1 -----wait-----

L2 XXXXXXXXXXX

The calibration takes approx. 20 sec. Then the display shows

L1 SET Umax

L2 YES = 1

When the voltage or current corresponding to the upper range limit is applied to the input, confirm this by input of 1 LOCAL ENTER.

The display shows

L1 -----wait-----

L2 XXXXXXXXXXX

The calibration takes approx. 60 sec. The display then returns to the standard display. The calibration is completed.

Switch-on the external setpoint from an analogue input as in Item 5.9.2.

5.10 Analogue outputs

Two analogue output channels are available at the socket "Temp.-Signal" 52 S (see Item 5.8). They can be set to carry the temperature values

T_i = bath temperature

T_1 = temperature at ext. Pt 100 T_1

T_2 = temperature at ext. Pt 100 T_2

T_S = setpoint.

5.10.1 Temperature signal channel 1

Channel 1 can be configured at socket 52 S on pin 2 as a voltage output or on pin 5 as a current output. Press the ANALOG I / O 1 key in SHIFT mode.

The display shows

L1 ANALOG INP/OUTP

L2 INP = 0 OUTP = 1

Select the processing of the outputs by pressing 1 LOCAL ENTER. The display shows

L1 Analog output

L2 Chan 1=1 Chan 2=2

Select channel 1 by pressing 1 LOCAL ENTER. The display shows

L1 Analog output

L2 U = 0 I = 1_

Select the current output with 1 LOCAL ENTER. The display shows

L1 CURRENT OUTPUT

L2 0-20=0 4-20=1

Select the required current range 0...20 mA or 4...20 mA by pressing 0 or 1 LOCAL ENTER.

The current range selection is omitted if the voltage range 0...10 V has been selected in the previous menu. The display shows the scalings available for selection.

L1 CONFIGURABLE=1

L2 analog output_

By pressing the ↓ — key (SHIFT ON) the preset scalings are displayed consecutively.

The selection is made by the input of the appropriate code (SHIFT OFF).

Configurable means that the temperature range required to correspond to the voltage range 0...10 V, current range 0...20 mA or 4...20 mA can be determined by setting the range start (T_{min}) and the range end (T_{max}).

The display shows

L1 CONFIGURABLE=1

L2 T_{min} =_ . °C

Example: range 20...220°C

Input 0, 2, 0, 0, 0 LOCAL ENTER

The display shows

L2 T_{max} =_ . °C

Input 2, 2, 0, 0, 0 LOCAL ENTER.

The following fixed scalings are available:

-200...400°C = 0...6 V = 10 mV/K

0°C = 2 V Code 2

-100...400°C = 0...10 V or 0...20 mA or 4...20 mA Code 3

0...100°C = 0...10 V or 0...20 mA or 4...20 mA Code 4

The display then shows

L2 Ti T1 T2 TS 0-3_

E.g. to set the bath temperature on channel 1 input 0 LOCAL ENTER.

Similarly for the temperature signal of the external Pt 100 T1 input 1 LOCAL ENTER etc.
The display then returns to the standard display.

5.10.2 Temperature signal channel 2

Channel 2 is purely a voltage output at socket 52 S on pin 1. The selection is made as described for channel 1 in Item 5.10.1 except that current ranges cannot be selected.

5.11 Safety functions

The built-in overtemperature limiter can be set over the complete operating temperature range.

The bath temperature is measured by a separate Pt 100 resistance sensor (TSi) and processed by a separate analogue/digital converter. The measured value is compared with the measured value of the bath temperature probe (Ti) continuously. If the measurements differ by more than ±18 K the thermostat switches off as in the case of a low-level or overtemperature fault.

The function of the microprocessor is monitored by an integrated watchdog circuit and an additional counter, which operates similarly to a normal watchdog circuit but is also capable of switching off the unit in case of a strobe failure.

When the set overtemperature switch-off point (TO) is exceeded the unit switches off permanently on all poles.

According to Class 2 a float switch with magnetic coupling (part of the level detector for level indication) acts as a low-level cut-out and also switches off the unit (pump and heater) permanently on all poles.

In both fault conditions the display indicates the corresponding message and additionally an audible signal draws attention to the fault ⚠.

The switch-off function of the safety circuit remains stored even during a break in the supply or after having switched off the supply.

Reset is possible by pressing the reset key 0, but only after having eliminated the troubles.

The pump motor is fitted with a temperature monitor which switches off if the motor winding overheats. The heater is also switched off simultaneously. After the motor winding has cooled down the pump starts up automatically.

Connection volt-free contact "Combined fault" 12 N (Alarm out)

3-pin flange connector conforms to NAMUR recommendation NE 28

1 = n.o. (make)
2 = common
3 = n.c. (break)

1,2 are linked when unit operation is OK.

Coupling socket 3-pin Cat. No. EQD 047

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

5.12 Checking the safety functions

5.12.1 Low-level cut-out

For correct operation of the low-level cut-out it is necessary that the float switch operates correctly. If the low-level cut-out is working according to 5.2.3 the check has been done during starting up. A check of a filled unit is only possible by checking the display during the draining process of the heat transfer fluid.

If the liquid level within the expansion tank falls below the indication pump and heater are switched off on all poles.

The display shows the message

L1 LEVEL

L2 TOO LOW

and there is a warning beep.

To restart, fill up the bath and press the reset key twice (with approx. 1 sec interval).

5.12.2 Adjustable overtemperature limiter

To check it the switch-off point TO has to be set below the current bath temperature.

Note that an input of TO below the setpoint TS produces the message

L2 TS >> TO

and the previous value for TO is retained.
Before carrying out this test the setpoint TS must normally first be lowered by a few degrees.
The overtemperature switch-off point can then be set e.g. 1K below the current bath temperature.

Example: T_i = 60°C

T_S = 60°C

T_O = 65°C

To check the operation of the overtemperature limiter, press

(SHIFT OFF). Input T_S = 20°C, press

, the display shows

L1 T_i = 60,00°C C

L2 T_O : 65,00°C T_i I

If T_u is shown in L2, press

again!

Now input 0, 5, 8, 0, 0

.

The switch-off point of the overtemperature limiter is now 2 K below the bath temperature T_i.

The display shows the message

L1 TEMPERATURE

L2 TOO HIGH!

with a beep. Heating and pump are switched off on all poles.

To restart the unit press the reset key

.

The display shows the standard display.

Now press

and set T_O to a value above the bath temperature, e.g. 70°C:

Input 0, 7, 0, 0, 0

. Then press the

key once more. The unit returns to normal operation.

<u>Caution:</u> In case of any malfunction in Items 5.12.1 and 5.12.2 the unit must immediately be taken out of use and checked by an engineer. Otherwise its safety is no longer ensured.

5.13 Digital serial interface RS 232 C

5.13.1 Plug connection and characteristics

9-pin sub-D socket 53 S

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

Cables used (computer end)

	Computer		Thermostat	
25-pin		9-pin	9-pin	
3	R x D	2	2	T x D (transmitted data)
2	T x D	3	3	R x D (received data)
7	SG	5	5	signal ground
6	DSR	6	6	DTR (data terminal ready)
4	RTS	7	7	CTS (clear to send)
5	CTS	8	8	RTS (request to send)

Using this interface it is possible to transfer the following data from or to a computer with a suitable interface:

1. Transfer of the setpoint from the computer to the thermostat
2. Read-out of the bath temperature T_i, the external temperature T_1, the external temperature T_2, and the setpoint of the unit
3. Transfer of the low temperature and overtemperature switch-off point
4. Read-out of the set overtemperature and low temperature switch-off point
5. Read-out of the fault signal
6. Transfer of the ramp segments and their processing
7. Status signal
8. Read-out of the control parameter and transfer
9. External controller status and start

5.13.2 General principles

The interface operates with two stop bits, no parity bit and with 8 data bits. The transfer rate can be set to 4800 baud or 9600 baud (see Item 5.3.5).

Values from the computer can be transferred directly to the thermostat, i.e. transmitted, e.g. OUT, SEG and START commands, or data can be transmitted from the thermostat to the computer on request with an IN command. An OUT, SEG or START command, if transmitted correctly, is always acknowledged by the thermostat with the message "OK" followed by LF and CR.

This message, like any other response, has to be requested by the computer!

Any output command (OUT, SEG, START, STOP) switches the thermostat to remote operation. This can be recognized by an R (setpoint source RS 232) on the right in L2.

Then all the keys are locked except for the functions SHIFT

and SHIFT

.

If no output command follows from the connected computer the keyboard can be activated until the next output command by pressing the keys SHIFT

.
The data requests by the thermostat (IN commands) only lock the programme keys SHIFT

and SHIFT

. All the other key functions are in operation.

In the following text the symbol "_" will be taken to mean blank (no character).

RS 232 interface and controller are operated by a single processor; for optimum control it is therefore advisable to have pauses of at least 100 msec between the interface commands.

5.13.3 Output commands

OUT_XXX.XX	Setpoint transfer with up to 3 places before the decimal point and up to 3 places behind. This includes the negative sign. Transfer can take various forms, e.g. for 5.00°C: 005.00, 05, 05.0, 005, 5.00.

A BASIC programme for the IBM PC which can be used to transfer any values between the set upper and lower limits (see Item 5.2.4) and which displays the response "O.K." or a possible error message may be as follows:

Note: set baud rate to 4800 (see Item 5.3.5)!

```
 10      OPEN  "COM1:4800,N,8,2"  AS #1
 20      CLS
 30      LOCATE 8,5:PRINT SPC(70)
 40      LOCATE 8,5
 50      INPUT "Enter your command (without OUT_)";VALUE$
 60      PRINT #1;"OUT_"+VALUE$
 70      INPUT #1;A$
 80      LOCATE 12,5:PRINT SPC(50)
 90      LOCATE 12,5:PRINT "Response of the thermostat";A$
100      TI = TIMER+1
110      IF TI > TIMER THEN 110
120      GOTO 30
130      END
```

The following values can be transmitted similarly to the thermostat:

OUT_LXXX.XX	switching point for low temperature (usually set to the lower range limit of the thermostat)
OUT_HXXX.XX	overtemperature switch-off point. For safety reasons it is essential that, after the transfer, this value is read back with the command IN_9 and checked!
OUT_XPXXX.XX	setting the control parameter X_p for the controller
OUT_TNXXX.XX	setting the control parameter T_n
OUT_TVXXX.XX	setting the control parameter T_v
OUT_RT1	switches the control variable to the source external Pt 100 T_1 (external control)
OUT_RT2	switches the control variable to the source external Pt 100 T_2 (external control)
OUT_RTi	switches the control variable to the source T_i (probe in the bath); control according to the bath temperature.
SEG_XXX.XX_XX:XX	using this programme segment command a segment can be written to the programmer buffer. It indicates the target temperature and the segment time hours (2 digits max.) and minutes (59 max.). The segment start is formed by the current setpoint, i.e. before the transfer of a programme segment it is useful to transfer a setpoint as a segment start suitable for the subsequent segment, using OUT_XXX.XX.

SEG_(XX)_XXX_XX:XX	single segment with segment number, used when whole temperature programmes are to be loaded from the computer to the thermostat. Thus, in contrast to the command SEG_, several segments may be transmitted. The programme starts with the latest setpoint; therefore please check before START whether the setpoint suitable for the first segment is available in the unit.
OUT_TBX.X	the tolerance range value is ½ of the value of the total range; i.e. 0.5 is 0.5 K; range 0.1...9.9 K. 0.0 switches off the tolerance range function.
OUT_CYXX	number of the programme cycles, range 1...99. 0 switches off the function, i.e. the programme is repeated until it is stopped manually.
START	starts the segment contained in the programme buffer
STOP	stops the programme segment run. With START the programme segment starts again from the beginning.

5.13.4 Requesting data from the thermostat

IN_1 indication of the bath temperature (T_i), i.e. request of the thermostat to transmit the bath temperature

IN_2 indication of the temperature value at the external probe T_1

IN_3 indication of the current setpoint (T_S)

IN_4 status signal, 7 characters

char 1 from left:	overtemperature fault = 1, no fault = 0
char 2:	low level fault = 1, level OK = 0
char 3:	programmer segment running = 1, programmer segment OFF = 0
char 4:	control according to the bath temperature (T_i) = 0, T_1 = 1, T_2 = 2
char 5:	setpoint set by analogue inputs = 1, analogue inputs OFF = 0
char 6:	indicates whether external Pt 100 T_1 is connected = 1, or not connected = 0
char 7:	indicates whether external Pt 100 T_2 is connected = 1, or not connected = 0

IN_5 invalid

IN_6 invalid

IN_7 indication of the temperature of the external probe T_2

IN_8 indication of the current low temperature switch-off point T_U

IN_9 indication of the current overtemperature switch-off point T_O

IN_A indication of the current value of X_p

IN_B indication of the current value of T_n

IN_C indication of the current value of T_v

Examples:

A BASIC programme with which values can be transferred from the thermostat to the computer and to display them, specifying the channel number (e.g. 1 for IN_1, i.e. the bath temperature), is as follows:

Note: set baud rate to 4800 (see Item 5.3.5)!

```
 10    OPEN "COM1:4800,N,8,2" AS #1
 20    CLS
 30    LOCATE 8,5:PRINT SPC(20)
 40    LOCATE 8,5
 50    INPUT "Channel No.";NO$
 60    PRINT #1;"IN_"+NO$
 70    INPUT #1;A$
 80    LOCATE 12,5:PRINT SPC(50)
 90    LOCATE 12,5:PRINT "Response of the thermostat";A$
100    TI = TIMER+1
110    IF TI > TIMER THEN 110
120    GOTO 30
130    END
```

The isolation of the status data may be as follows:

LEFT $ (A$,1)	=	overtemperature fault
MID $ (A$,2,1)	=	low-level fault
MID $ (A$,3,1)	=	programme segment running
MID $ (A$,4,1)	=	control by T_i, T_1 or T_2
MID $ (A$,5,1)	=	analogue input on/off
MID $ (A$,6,1)	=	external Pt 100 T_1 connected
RIGHT $ (A$,1)	=	external Pt 100 T_2 connected

5.13.5 Error messages on the computer

The following error messages can be reported from the thermostat to the computer during operation:

ERR-2: invalid inputs (e.g.: overflow of the input buffer)
ERR-3: invalid command
ERR-5: invalid command when switching the control variable for the controller, e.g. external controller OUT_RT2. Other command than OUT_RTI, OUT_RT1, OUT_RT2.
ERR-6: temperature value cannot be set
ERR-7: syntax error in channel number
ERR-8: channel does not exist

5.14 Timing clock function

The unit is equipped with a clock indicating day, month, year, weekday, hours and minutes and provides these for the timing function.

The clock is backed for approx. 10 years by a built-in battery so that the clock continues to operate even when the unit is not connected to the electrical supply.

5.14.1 Setting and indication of date and time

This function is only required when changing from summer to winter time and vice versa, or when the unit is being operated in other time zones. Date and time are set at the factory when the unit is started up for the first time.

By pressing the

key in the SHIFT mode the display shows

L1 Clock = 0 Activ = 1

L2 SET = 2 FUNCT = 3

By the input of 0

date and time are indicated.

returns to the standard display.

The input of 2

(SET) allows date and time to be altered. The display shows:

L1 DA MO YE H MI

L2 _ . . :

Day, month, year, weekday, hours and minutes are now input in sequence.

Weekday code:

1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday
7	Sunday

The hours are input from 0 to 24 (factory-set to Central European Time).

Example: L2 19.01.94 3 16:05

Terminate the input with LOCAL ENTER

5.14.2 Timing clock function

By pressing the 2 key in the SHIFT mode the display shows the menu as described in Item 5.14.1.

Select the timing function FUNCT = 3 with 3 LOCAL ENTER.

The display shows

L1 Thermostat ON = 1

L2 OR OFF = 0

Here it can be selected whether the thermostat should automatically switch on or off at the time to be selected subsequently in Item 5.14.3. Input either 1 or 0 as appropriate. A display to input date and time appears.

Input here the switching point for the timing function as described in Item 5.14.1 and enter it with LOCAL ENTER. The display returns to the standard display.

5.14.3 Activating the timing function

By pressing the 2 key in SHIFT mode the display shows the selection menu as described in Item 5.14.1. Activate the timing function with ACTIV = 1 by the input of 1 LOCAL ENTER.

Again the display shows

L1 Clock

L2 ON = 1 OFF = 0

Normally 1 [LOCAL ENTER] is input here to activate the timing function.

The timing clock symbol now appears in line L1 before the last position. If the previous selection was that the thermostat should switch on automatically, the thermostat now switches off and starts up at the selected time.

When the unit has been switched off through the timing function, the display shows

L2 CLOCK STOP!

The activated timing function can always be switched off with off = 0, i.e. with 0 [LOCAL ENTER].

In addition the timing function can be cancelled at any time with [ESC].

6 Bath liquids and hose connections

6.1 Bath liquids

Water must not be used!

For use with the high-temperature thermostat USH 400 we recommend to use our organic heat carrier liquid.

Ultra-Therm 330 SCB Cat. No. LZB 007

This liquid can be used for operating temperatures from 30 to 330°C.

viscosity at 20°C	47 mm^2/s
flash point	>240°C
boiling point	385°C

Data sheet according to EU Guidelines is available on request.

Fresh heat carrier liquid should be carefully heated up, also when the thermostat is re-filled. Operate the completely installed equipment initially for several hours at 100°C. Then raise to the required operating temperature in steps of about 50°C, holding each time for about 30 minutes.

All suitable organic liquids must not come into contact with non-ferrous metals and oxygen when hot, otherwise their life is greatly reduced. The USH 400 therefore has in the expansion tank a quantity of cold oil whose temperature during continuous operation is between 30°C and a maximum of 100°C. If higher temperatures should be reached after a longer period, despite observing the instructions of Item 4.4, this is certainly caused by faulty conditions of the complete system or of the bath liquid.

6.2 Hose connections

For safety reasons it is recommended to use only flexible metal hoses over the entire operating temperature range.

Metal hoses (single-layer insulation)

Temperature range 0...400°C

Metal hose MC	50	(50 cm long)	Cat. No. LZM 040
Metal hose MC	100	(100 cm long)	Cat. No. LZM 041
Metal hose MC	150	(150 cm long)	Cat. No. LZM 042
Metal hose MC	200	(200 cm long)	Cat. No. LZM 043

Metal hoses with special insulation (3-layer insulation)

Temperature range 0...350°C

Metal hose MC	50 S	(50 cm long)	Cat. No. LZM 046
Metal hose MC	100 S	(100 cm long)	Cat. No. LZM 047
Metal hose MC	150 S	(150 cm long)	Cat. No. LZM 048
Metal hose MC	200 S	(200 cm long)	Cat. No. LZM 049

Highly-flexible, thermally insulated stainless steel (V2A) metal hoses with M 16 x 1 mm connecting thread. Int. diameter 10 mm. These hoses offer optimum security.

7 Maintenance

7.1 Safety notes in case of repairs

Always pull out the mains plug for all repair and cleaning operations! Repairs on the control unit with the cover removed must be carried out by a qualified electrician only .

7.2 Repairs and re-initialisation

LAUDA thermostats are largely free from maintenance. Dirty thermostatic liquid should be removed through the drain cock and replaced. If the unit should become faulty it may be advisable to return only the faulty module where appropriate.

When replacing the control unit, check whether the new control unit has been programmed for the correct basic unit type. If the correct type does not appear after having switched on the mains switch, proceed as follows:

Mains switch off, press the keys SHIFT and PAR 6 simultaneously and at the same time switch on the supply.

Wait until the following display appears:

L1 RK 20 K = 0 K 12 K = 1

L2 Type

Release the keys SHIFT and PAR 6, and go through the menu with the key ↓ — until the required type appears. Input the code number and enter with LOCAL ENTER.

The type designations are shown abbreviated, e.g. C 6 C instead of C 6 CP.

There is no provision for a fuse for the complete unit since the necessary 16A fuse corresponds to the mains fuse usually provided at the location. The control circuit of the unit has a separate fuse; a fuse 5 x 20 F4A is located in the control unit. This is accessible after removing the cover. When the fuse has blown the green lamp in the mains switch does not light up.

7.3 Cleaning

The unit can be cleaned using a cloth moistened with water with the addition of a few drops of (domestic) detergent. No water must find its way into the control unit.

The user is responsible for any necessary decontamination if dangerous materials have been spilled on or inside the unit. This applies in particular if the unit is removed for a different use, for repair, storage etc.

The method of cleaning or decontamination is determined by the expertise of the user. If the user has any doubts on whether this may damage the unit he has to contact the manufacturer.

7.4 Spares ordering

When ordering spares please specify the equipment type and number on the label. This avoids queries and prevents the supply of wrong goods!

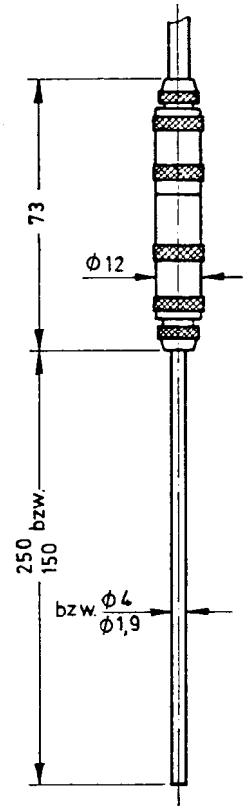
LAUDA Service Constant Temperature Equipment
Telephone: 0049 9343/ 503-236 (English and German)
Fax: 0049 9343/ 503-283
E-Mail service@lauda.de

We shall always be happy to deal with queries, suggestions and complaints.

LAUDA DR. R. WOBSER GMBH & CO. KG
P.O. Box 1251
97912 Lauda-Königshofen
Germany
Telephone: +49 (0) 9343/ 503-0
Fax: +49 (0) 9343/ 503-222
E-mail info@lauda.de
Internet http://www.lauda.de

8 Accessories

Type	Cat. No.
Controlled cooling MVH Cooling device with solenoid valve for cooling water	LTZ 034
Automatic exhausting valve	UD 253
Extra expansion vessel of approx. 1 l	UD 260



LAUDA Pt 100 platinum resistance thermometers

Pt 100-70
Stainless steel protection tube 4 mm dia.
Temp. range -200...300°C
50% response time 1.5 sec
Length 250 mm — Cat. No. ETP 009

Pt 100-72
Stainless steel protection tube 4 mm dia.
Temp. range -200...800°C
50% response time 7,5 s
Length 250 mm — Cat. No. ETP 011

Pt 100-80
Stainless steel protection tube 1,9 mm dia.
Temp. range -200...300°C
50% response time below 1,5 s
Length 150 mm — Cat. No. ETP 012

Connecting cable Plug 42 S to Pt 100-70, 72, 80 — Cat. No. UK 095

Longer control cable to connect thermostat with controller
Length max. 20 m; required length to be indicated — Cat. No. UK 186

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X30 Netzspannung	100V	230V
100V	X	
115V	X	
230V		X

X31.X32	AC	DC
CxP.KxP	X	
DxP.DLxP	X	
RCxP.RKxP	X	
RLxP.RUL30		X
RUKxx		X
R400P	X	
R403PL.R406PL	X	

Anschlußbelegung

53 S

RS 232

TxD RxD GND

R403PL
R406PL

H1

A1 A2 A3 A4 A5

Ti 100,00 °C

Ts 100,00 °C

X6 12V Alarm OUT

X7 14V Alarm IN

X5 52S Analog Ein/Aussang
1 Aussang Kanal 2
2 Aussang Kanal 1
3 GND
4 0-10V Einsang
5 I-Aussang
6 0-24mA Einsang

X30 230V 115V 110V

X31 X32 AC DC

ab Seriennr. Y10...

				Datum	08.08.1994	LAUDA Dr.R.Wobser GmbH & Co KG	Schaltplan Schéma de connexions Circuit diagram	xxP	
				Bearb.	B.Schmies				
				Datum	7.6.95				Blatt 1
Zust.	Änderung	Tag	Name	Gepr.		Ursprung	Ersatz	Ersatz	8 81.

97.06. 0

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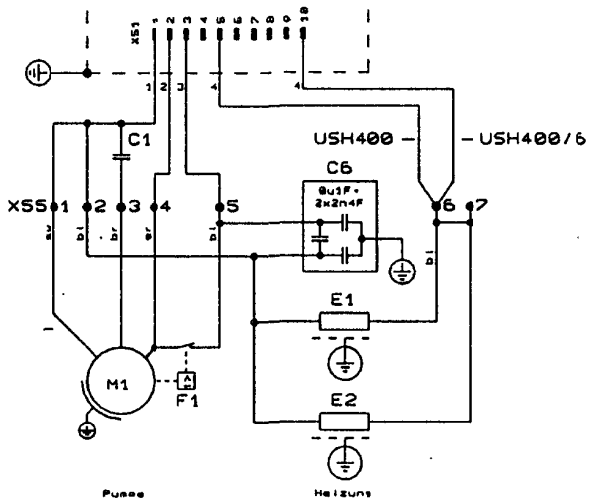
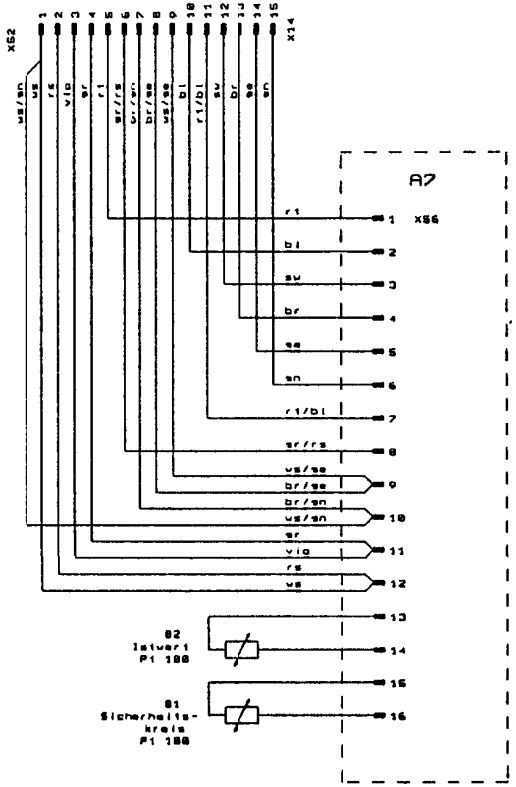
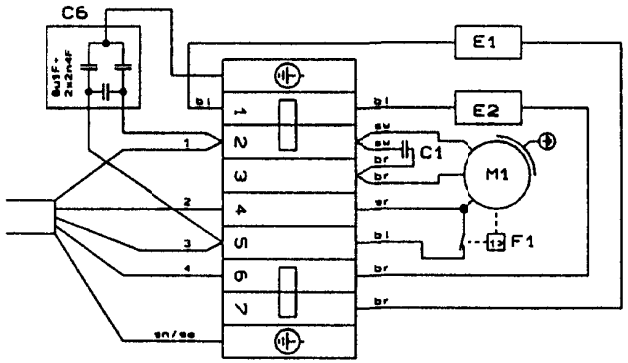




Anschlußplan



				Datum	13.03.1996		LAUDA Dr.A.Voßeler GmbH & Co KG	Schaltplan Schéma de connexions Circuit diagram	USH400 / USH400/6
				Bearb.	B.Schmies				Blatt 2
				Datum	12.3.96				2 Bl.
Zust.	Änderung	Tag	Name	Gepr.		Ursprung	Ersatz	Ersatz	

13.03.96

Geräteliste Schaltplan **List of parts Circuit diagram** **Liste de pièces schéma de connexions** **230V/400V;3/N/PE 50Hz**		**USH 400**	**USH 400/6**
A 7	Leiterplatte „Schwimmer" Printed circuit board „Float" Circuit imprimé „Flotteur"	UL 474	UL 474
B 1	Pt 100 Fühler Sicherheitskreis Pt 100 Probe Safety circuit Pt 100 Sonde Circuit securité	ETP 054	ETP 054
B 2	Pt 100 Fühler Istwert Pt 100 Probe actual value Pt 100 Sonde valeur réelle	ETP 037	ETP 037
C 1	Motorkondensator Motor condenser Condensateur moteur	7 uF ECA 004	7 uF ECA 004
C 6	Entstörkondensator Interference capacitor Condensateur d'antiparasitage	ECF 001	ECF 001
E 1	Heizkörper Heater Corps de chauffe	230V UH 139	400V UH 145
E 2	Heizkörper Heater Corps de chauffe	230V UH 140	400V UH 146
F 1	Klixon (Intern) Klixon Klixon	------	------
X 51	Steckereinsatz 10pol. + Anbaugehäuse Plug 10 channels + extra housing Connecteur 10 pôles + boîtier supplémentaire	EQS 031+ EQG 016	EQS 031+ EQG 016
X 52	Steckleiste SUB-D 15 pol. + Gehäuse Plug strip SUB-D 15 channels + housing Réglette à fiches mâles 15 pôles + boîtier	EQM 080+ EQG 027	EQM 080+ EQG 027
X 53	Reihenklemme Line up terminal Barrette à bornes	7x EZK 035 2x EZK 036	7x EZK 035 2x EZK 036
X 56	Steckleiste 16pol. (Schwimmer) Plug strip terminal (Float) Réglette à fiches mâles (Flotteur)	EZK 064	EZK 064

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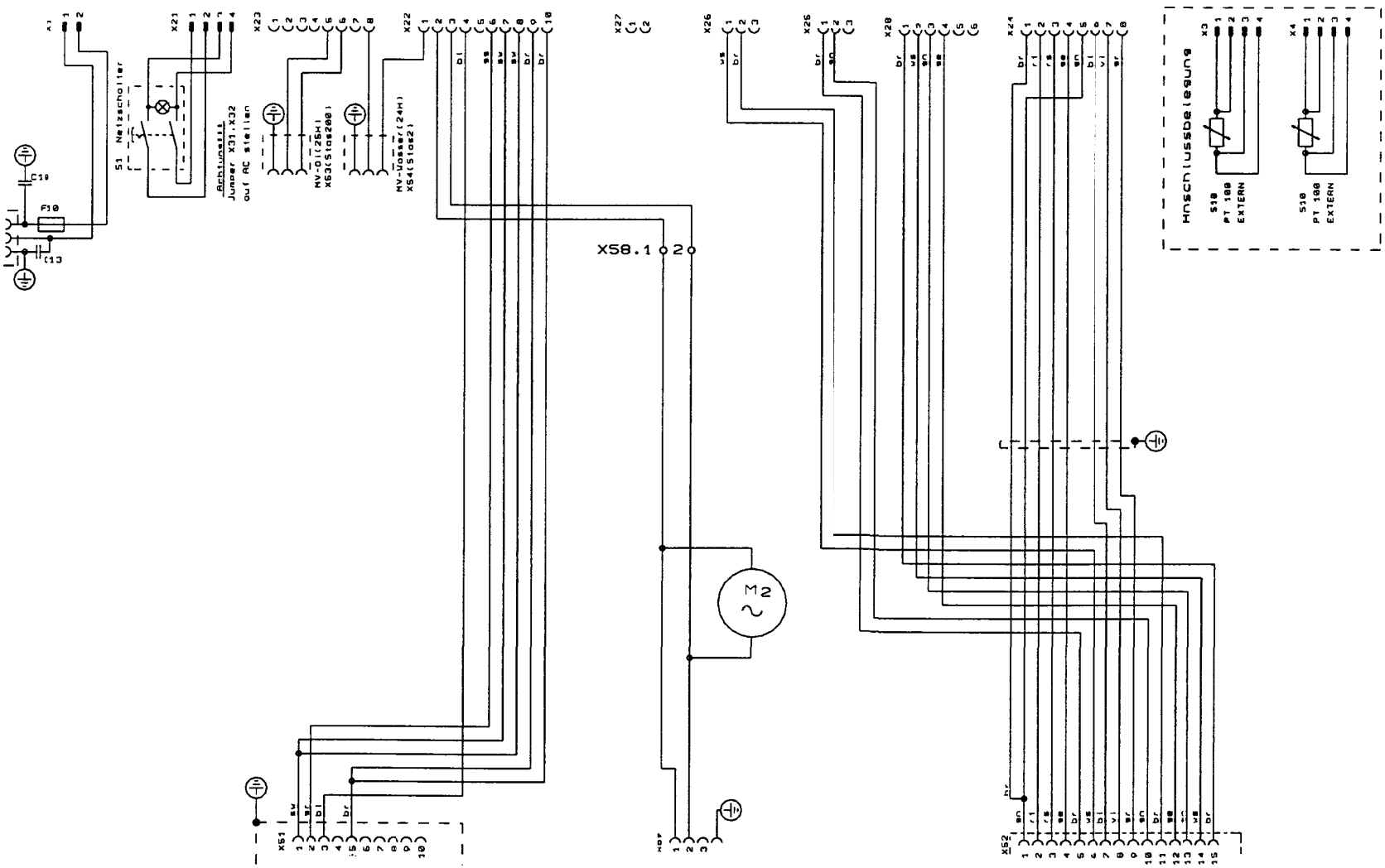
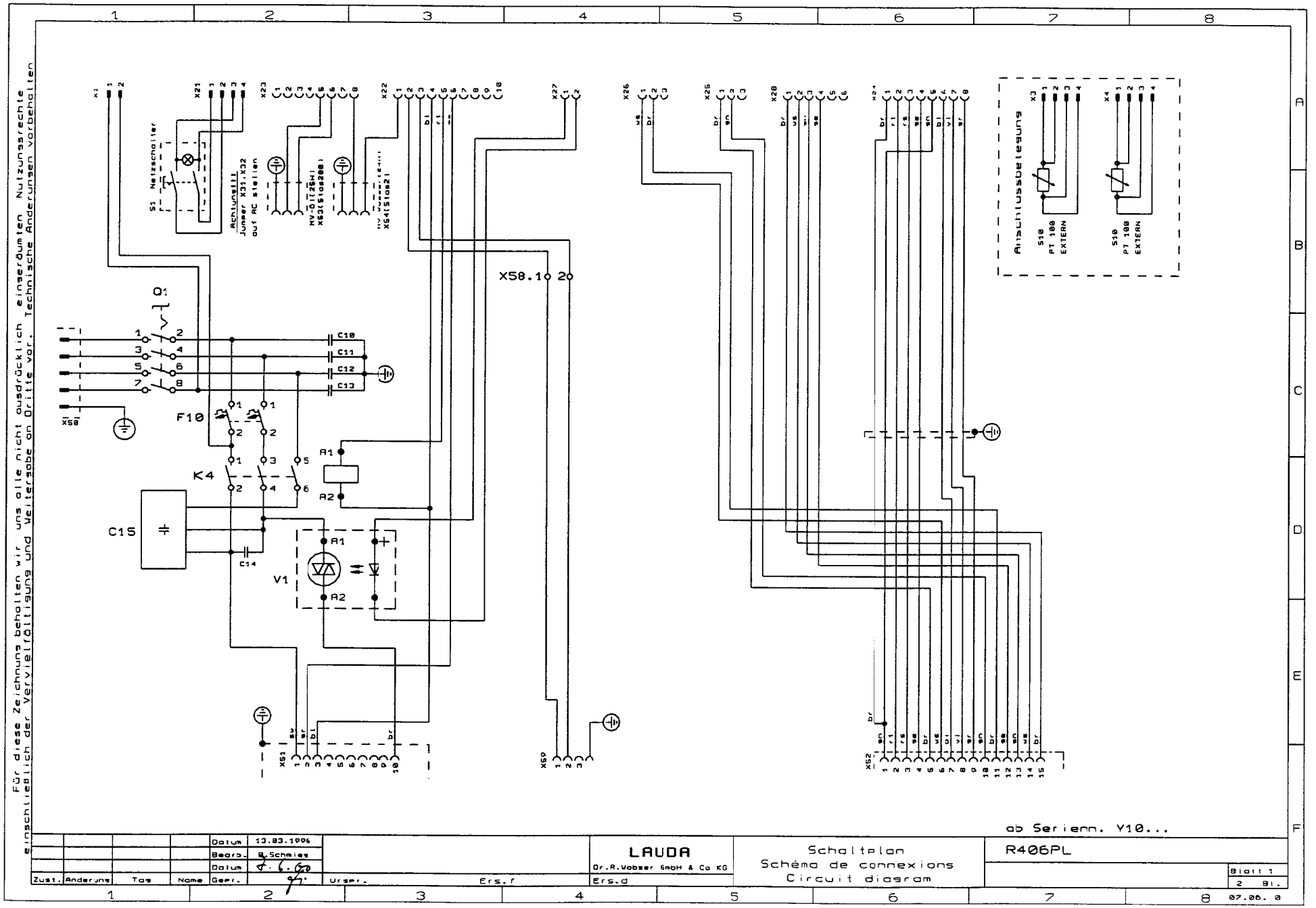


				Datum	13.03.1996		LAUDA Dr.R.Wobser GmbH & Co KG	Schaltplan Schéma de connexions Circuit diagram	R403PL	
				Bearb.	B.Schmies					
				Datum	7.7.97				Blatt 1	
Zust.	Änderung	Tag	Name	Gepr.		Urspr.	Ers.f	Ers.d	2 Bl.	

1 2 3 4 5 6 7 8 — A B C D E F — 97.05. 0


Für diese Zeichnung behalten wir uns alle nicht ausdrücklich eingeräumten Nutzungsrechte einschließlich der Vervielfältigung und Weitergabe an Dritte vor. Technische Änderungen vorbehalten
S1 Netzschalter
Achtung!!! Jumper X31.X32 auf AC stellen
Q1
F10
K4
C15
V1
X58.1
X58
X59
X51
X52
Anschlussbelegung
X3
X4
S10 PT 100 EXTERN
S10 PT 100 EXTERN
ab Seriennr. Y10...
LAUDA
Dr.R.Wobser GmbH & Co KG
Schaltplan
Schéma de connexions
Circuit diagram
R406PL
Datum 13.03.1996
Bearb. B.Schmies
Datum 4.6.96
Zust. Änderung Tag Name Gepr.
Urspr. Ers.f Ers.d
Blatt 1
2 Bl.
07.06. 0

Geräteliste Schaltplan **List of parts Circuit diagram** **Liste de pièces schéma de connexions** **230V/400V;3/N/PE 50Hz**		**R 403 PL**	**R 406 PL**
A 1	Leiterplatte „MP Netz" Printed circuit board „MP-Mains" Circuit imprimé „MP-Secteur"	UL 382-1C	UL 382-1C
A 2	Leiterplatte „CPU" Printed circuit board „CPU" Circuit imprimé „CPU"	UL 383-1A	UL 383-1A
A 3	Leiterplatte „Anzeige Tastatur" Printed circuit board „Indication Keyboard" Circuit imprimé „Affichage Clavier"	UL 384-1B	UL 384-1B
A 4	Leiterplatte „Analog Ausgang" Printed circuit board „Analog exit" Circuit imprimé „Sortie analogue"	UL 385-1	UL 385-1
A 5	Leiterplatte „Anzeige Display" Printed circuit board „Indication Display" Circuit imprimé „Affichage Display"	EAO 091	EAO 091
C 10, C 13	Y-Kondensator Y-Condenser Y-Condensateur	ECF 023	ECF 023
C 11, C 12	Y-Kondensator Y Condenser Y-Condensateur	------	ECF 023
C 14	MKP-Kondensator MKP-Condenser MKP-Condensateur	------	ECA 007
C 15	Entstörfilter Interference filter Filtre d'antiparasitage	------	ECF 028
F 10	Steuersicherung Mains fuse Fusible commande	FF16A / EES 003	2x S281-B16 / EEA 003
	Sicherungshalter Fuse holder Porte-fusible	EEH 026	------
K 5	Schütz Heizung Contactor Heater Contacteur Chauffage	------	ERL 014
M 2	Lüfter Fan Ventilateur	EML 006	------
Q 1	Hautpschalter Mains switch Interrupteur général	------	ESP 009
S 1	Netzschalter Steuerung Mains switch Control Interrupteur secteur Commande	EST 032	EST 032
V 1	Solid state relay	------	EYY 027
X 22	Plug strip terminal Steckleiste 10pol. Réglette à fiches mâles	EZK 056	EZK 056

Geräteliste Schaltplan **List of parts Circuit diagram** **Liste de pièces schéma de connexions** **230V/400V;3/N/PE 50Hz**		**R 403 PL**	**R 406 PL**
X 23	Steckleiste 8pol. (Magnetventil) Plug strip terminal (Solenoid valve) Réglette à fiches mâles (Vanne solenoide	EZK 057	EZK 057
X 24	Buchsenleiste 8pol. (PT100 IST/SI) Socket terminal strip Réglette à douille	EQG 025	EQG 025
X 25	Buchsenleiste 3pol. (Niveausensor) Socket terminal strip 3pol. (Level sensor) Réglette à douille 3pol. (Détecteur de niveau)	EQG 024	EQG 024
X 26	Buchsenleiste 3pol. (KTY 81) Socket terminal strip 3pol. (KTY 81) Réglette à douille 3pol. (KTY 81)	EQG 024	EQG 024
X 27	Buchsenleiste 2pol. (Steuerung SSR) Socket terminal strip 2pol. (Control SSR) Réglette à douille 2pol. (Commande SSR)	EQG 024	EQG 024
X 28	Buchsenleiste 3pol. (Niveauanzeige) Socket terminal strip 3pol. (Level indication) Réglette à douille 3pol. (Indication niveau)	------	EQG 010
X 29	Buchsenleiste 2pol. (Leuchtdiode) Socket terminal strip 2pol. (Luminous diode) Réglette à douille 2pol. (Diode lumineuse)	EQF 067	EQF 067
X 50	Netzanschluß Mains connection Branchement secteur	EQD 030	EQD 032
X 51	Steckdoseneinsatz 10pol. + Anbaugehäuse Plug 10 channels + extra housing Connecteur 10 pôles + boîtier supplémentaire	EQD 026+EQG 019	EQD 026+EQG 019
X 52	Buchsenleiste SUB-D 15 pol. Socket terminal strip SUB-D 15 channels Réglette à douille SUB-D 15 pôles	EQF 076	EQF 076
X 53	Anschlußbuchse f. MVH-Olventil 25H Connection socket for MVH-Oil valve Douille de branchement pour MVH-Vanne d'huile	EQD 037+EQZ 006	EQD 037+EQZ 006
X 54	Anschlußbuchse f. MVH-Kühlwasserventil 24H Connection socket for MVH-Cooling water valve Douille de branchement pour MVH-Vanne de réfroidissement	EQK 004+EQZ 006	EQK 004+EQZ 006
X 58	Klemme + Abschlussplatte Terminal + Cover Borne + Plaque	2x EZK 134 + EZK 140	2x EZK 134 + EZK 140
X 59	Einbausteckdose (Pumpe) 50H Socket (Pump) Prise (Pompe)	EQD 032	EQD 032

Notes for trouble-shooting for LAUDA Thermostats with P - electronics

Each repair requiring the opening of the control part by means of tools and each work at the electronic part may only be done by a trained technician !

Malfunction	Fault	Reason	Remedy
Green signal lamp of mains switch not alight	Control fuse has actuated		Replace fuse on PCB ”MP Mains” 5 x 20; F4A
		Overload on PCB	Replace PCB ” MP Mains ”
Display: ”Level too low ”	Bath level too low	Evaporation; external consuming device not refilled	Fill in bath liquid; press reset button twice
		Leakage in hose connections	Check hoses and their connection; if necessary replace them; fill in bath liquid; press reset button twice
	Level detector		Check level detector, plugs and hall sensors; if necessary replace them; check their function carefully For USH 400(/6) fill in bath liquid up to the level mark
Display: ” Temperature too high ”	Temperature probe	Temperature difference between two probes > 15°C	Replace bath temperature probe (double Pt 100). For USH 400(/6) please check both single Pt 100.
	Temperature of bath liquid above over-temperature switch-off point (To)	Overtemperature switch-off point (To) set too low	Press reset button; adjust overtemp. switch-off point (To) at an higher value; press reset button
		Triac or triggering	Replace triac or PCB "MP Mains"
Display: ” External fault "	Contact input 14 N ”Fault ” is used	Pins ½ not connected	Reason for malfunction caused by external system
		No signal transmitter connected to socket 14 N, though selection at PAR level is activated	Switch off function ” Contact input Fault ” at PAR level; see operating instructions
Display: ” Ts > To	Wrong inputs	Setpoint adjusted above overtemperature switch-off point (To)	Adjust overtemperature switch-off point (To) at an higher temperature; pay attention to bath liquid, flash point etc. !!
		Overtemperature switch-off point adjusted below setpoint (Ts)	First adjust setpoint (Ts) at a lower value then set requested overtemperature switch-off point
Display: “Ts < Tu”	Wrong input	Setpoint adjusted below low-temperature switch-off point (Tu)	Adjust low-temperature switch-off point (Tu) at a lower value
		Low-temperature switch-off point adjusted above setpoint (Ts)	First adjust setpoint at an higher temperature then set requested low-temperature switch-off point (Tu)

Notes for trouble-shooting for LAUDA Thermostats with P - electronics

Malfunction	Fault	Reason	Remedy
Setpoint Ts is not adjustable but will disappear	Operating error	Setpoint is determined by the analogue input; see right side of display L2: A	Switch off analogue input
Sound signal appears when a button is pressed		Another function blocks the keybord e.g.: programme runs; RS 232 active; Parameter etc.	Leave the function or press ESC (RS 232) (R appears on the right side of display L2); Stop access and press the button “Local”
Display: ”Tu – Cursor flashes” acoustic signal switches compressor off after 1 min.	Wrong input	Actual value is $\leq$ = Tu, resp. setpoint adjusted too close to low-temperature switch-off point Tu; bath temperature (Ti) falls below Tu	Set low-temperature switch-off point (Tu) at a lower value
Display ”Out of range”	Wrong input	Tried to enter values being out of admissible ranges; Ts,To,Tu being out of operating temp.	Choose the right values taking into consideration their limitations; check bath liquid or configuration after having switched on the unit
		Programme input out of operating temperature range of the unit	Enter admissible values
		Value for Xp, Tn, Tv above 199,9	Enter admissible values
Tu or To is not adjustable; “Out of range ”		Input values are outside of temperature limits of the type of unit or initialization does not fit to the type of unit	Reinitialize type of unit: (see operating instructions “Maintenance”); may also return ***Default-values***
Display: “TA” (only for USH 400(/6)		Motor chamber temperature > 55 °C	Surrounding temperature of the part of the thermostat may be too high (see operating instructions 5.2.8)
Display: ↓ (only for USH 400(/6) RUL and RUK)		Level too low	Fill in bath liquid ; (see operating instructions 5.2.3)
Display: ↑ (only for USH 400(/6) RUL and RUK)		Level in the vessel is close to overflow; heater switches off	Either reduce the amount of thermal liquid or install an other vessel Attention: HOT !!!
Display: “Upper limitation of oil > limitation of unit” (cancelled beginning with software version 1.06)		Admissible working temperature range of bath liquid exceeds operating temperature range of the unit	Bath liquid is accepted, no other steps necessary; unit limitations valid
Setpoint cannot be selected by means of keyboard		Check setpoint selection; see right side of display L2; P=Programme; A=Analogue; R=RS 232	Switch setpoint selection to I=Internal
Display: “External fault – clock stop!”	Clock does not run	RAM defective	Unit has to be switched on once again; set date and time once again; see operating instructions if necessary replace RAM

Notes for trouble-shooting for LAUDA Thermostats with P - electronics

Malfunction	Fault	Reason	Remedy
Display: "Internal Pt 100 defective"	Double Pt 100 for bath temperature or safety temperature	Interruption, short circuit or temperature deviation of bath temperature probes too important	Replace double Pt 100 for bath temperature For USH 400(/6) please check both single Pt 100
Display: "Ext. Pt 100 not connected"		Tried to switch over to external control without connecting an external Pt 100	Continue to work with internal control or connect external Pt 100 for T1 or T2; look at display for control variables I, 1 or 2; check display for T1 or T2
		Tried to calibrate Pt 100 being not connected	
Display: "Correcting value too high"	Important deviation of Pt 100 from standard values	Value input differing from the basic value that is indicated by more than 5 K	Check temperature reference thermometer, check Pt 100; replace PCB "CPU"
Scale of analogue outputs shows discrepancies		Outputs not correctly calibrated	Calibrate the analogue output channels (see operating instructions)
Unit does not heat though heating is indicated	Triac		Replace triac
	Heater	Defective	Replace heater
		Interruption	Eliminate
		Electronics	Replace PCB "MP Mains"
		Controller output limitation at PAR level too small	Enter higher values at PAR level (e.g. 100 %)
Pump does not run	Temperature safety cut-out in pump has actuated Pump stops	Motor blocked	Turn propeller of motor; if necessary replace it; clean pump
		Viscosity of bath liquid too high	Use other bath liquid; wait until motor has cooled down
Bath temperature rises clearly above adjusted setpoint (Ts) Heating indication ON		Controller	Replace PCB "MP Mains" or PCB " CPU "
Heating indication OFF		Triac	Replace triac
Temperature rises slowly above adjusted setpoint Heating indication OFF	Cooling not sufficient	Heat emission of pump	Connect cooling water supply or other kind of cooling
Display shows wrong temperature (Ti, T1, T2)		Temperature probe	Replace double Pt 100 or external Pt 100 T1, T2
Display is dark	Temperature cut-out in transformer has actuated	Overload caused by short – circuit	Replace PCBs or control unit

Notes for trouble-shooting for LAUDA Thermostats with P - electronics

Malfunction	Fault	Reason	Remedy
Unit does not work at adjusted setpoint		Wrong control parameters adjusted	Enter new values or start autoadaption
Temperature control by means of external controller not stable		Thermal contact of bath liquid and external measuring point not sufficient	Improve circulation through external consuming device or thermal contact to ext. Pt 100
Unit does not cool down		Controller output limitation at PAR level too small	Adjust higher value at PAR level (e.g. -100 %)
	Compressor defective		Replace refrigeration unit – by refrigeration engineer !!
	Leakage in refrigeration system		Clear leakage, fill in refrigerant – by refrigeration engineer !!
	Compressor does not run	Compressor without tension	Eliminate line interruption
		Triggering defective	Replace PCB ”MP Mains ”
Unit does not cool down	Compressor does not run	Pressure switch has actuated	Unscrew grid, clean condenser, blow through compressed air, improve ventilation
	Solenoid valves do not work correctly	Triggering defective	Replace PCB ” MP Mains ”
Compressor switches ON and OFF in regular periods; temperature constancy very bad	Condensation pressure too high	Fan defective	Replace fan motor
		Fan speed (only RK)	Check speed or speed controller
	Condenser dirty	Dust	Unscrew grid, from the back side blow compressed air or nitrogen through condenser
		Ventilation disturbed	Enlarge distance to nearby units or walls
		Ambient temperature too high	Air the room
Insufficient cooling in the lower temperature range		Bath liquid contaminated by condensate	Replace bath liquid to suit bath temperature
	Cools down to approx. 0°C only	Bath liquid not suitable (water)	Use water/ glycol mixture

BESTÄTIGUNG / CONFIRMATION / CONFIRMATION

An / To / A:
LAUDA Dr. R. Wobser • LAUDA Service Center • Fax: +49 (0) 9343 - 503-222

Von / From / De :

Firma / Company / Entreprise: _____

Straße / Street / Rue: _____

Ort / City / Ville: _____

Tel.: _____

Fax: _____

Betreiber / Responsible person / Personne responsable: _____

Hiermit bestätigen wir, daß nachfolgend aufgeführtes LAUDA-Gerät (Daten vom Typenschild):
We herewith confirm that the following LAUDA-equipment (see label):
Par la présente nous confirmons que l'appareil LAUDA (voir plaque signalétique):

Typ / Type / Type :	**Serien-Nr. / Serial no. / No. de série:**

mit folgendem Medium betrieben wurde
was used with the below mentioned media
a été utilisé avec le liquide suivant

_____

_____

_____

_____

Darüber hinaus bestätigen wir, daß das oben aufgeführte Gerät sorgfältig gereinigt wurde, die Anschlüsse verschlossen sind, und sich weder giftige, aggressive, radioaktive noch andere gefährliche Medien in dem Gerät befinden.

Additionally we confirm that the above mentioned equipment has been cleaned, that all connectors are closed and that there are no poisonous, aggressive, radioactive or other dangerous media inside the equipment.

D'autre part, nous confirmons que l'appareil mentionné ci-dessus a été nettoyé correctement, que les tubulures sont fermées et qu'il n'y a aucun produit toxique, agressif, radioactif ou autre produit nocif ou dangeureux dans la cuve.

Stempel **Seal / Cachet.**	**Datum** **Date / Date**	**Betreiber** **Responsible person / Personne responsable**

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